

Marine Engineering

Vol. 6.

NEW YORK, DECEMBER, 1901.

No. 12

THE WORKS OF THE NEW YORK SHIPBUILDING COMPANY.

Taking the great shipyards of the world we find that with but a single notable exception all are the result of many years growth and development. A few have built steel ships from the first, but even these were not thoroughly equipped, and machinery and tools for handling large work were only supplied in after years. The majority of yards were started many years before the advent of labor saving machinery, so

were designed by the engineers of the company for special work.

In all departments leading engineers were consulted so that each would be laid out according to most advanced practice. The mechanical, civil, marine, electrical, sanitary, and heating and ventilating engineers, the architect and specialists of the various crafts were all called upon in laying out these great works and above all, each department was designed to carry on its work in accord with other departments, so that

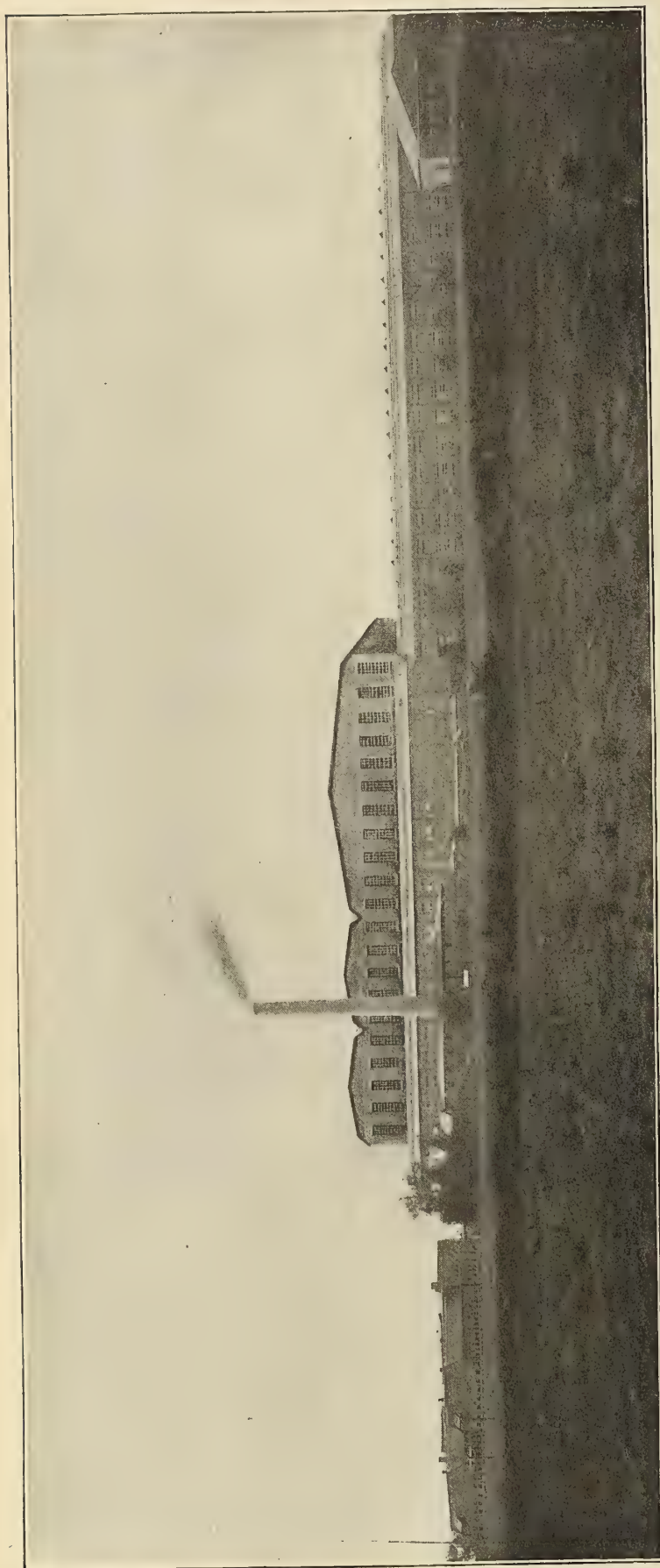


MACHINE SHOP NEW YORK SHIPBUILDING CO., FROM THE FLOOR, LOOKING NORTH.

that when such equipment was afterwards installed it could not, in the nature of the case be used to the greatest advantage.

On the banks of the Delaware opposite the city of Philadelphia lie the works of the New York Shipbuilding Company, representing in all the various departments of shipbuilding the most advanced engineering ideas. This Yard may indeed be said to have sprung into existence a finished product. None but modern tools and machines were bought to equip the various departments, and many machines are now in use which

the entire plant should work in harmony. Mr. Henry G. Morse is the man who conceived this great project, designed the plant, and has successfully carried it through. He began the work in the middle of September, 1898, and as no site had been selected he was unrestricted by local conditions. Drawings for an ideal plant were made, and after examining many sites on the harbors from New York to Virginia, the one opposite Philadelphia was chosen as fulfilling all the requirements. The most important points to be considered were, area of land available, quality of soil



GENERAL VIEW OF THE WORKS OF THE NEW YORK SHIPBUILDING COMPANY FROM THE EAST.

The main office building is at extreme left, at the right of this is the Power House. The Machine Shop is in the center with the Ship Sheds rising immediately behind. The extension at the right contains under one roof the Boiler, Blacksmith, Angle and Plate Shops. The Storage Shed is at extreme right.

on which depend stability of foundations and health of the locality, cost of property, cost of grading and pile work, depth of water, railway facilities and proximity to a good labor market.

The property selected comprises 141 acres at the southern end of Camden, N. J., with a water frontage of 3,600 feet on the east bank of the Delaware River. It is bounded on the north by the Reading Railroad, on the east by the Reading and the Pennsylvania tracks, and on the south by Newton Creek. Extensive dredging has been carried on by which a depth of 40 feet of water at low tide is secured along the entire

water front. The discharge from the suction dredges which were employed was taken through pipes to the shore. In this way many acres of land have been made. The depth of property is from 1,500 to 1,800 feet from the riparian line. The soil above and below water is a fine sand.

The buildings are of steel construction with brick curtain walls.

The system by which work is carried on is very complete and permits of locating any piece of material in any part of the yard, and by a simple system of numbering indicates through which department the piece is

to pass and the work to be performed upon it in each shop.

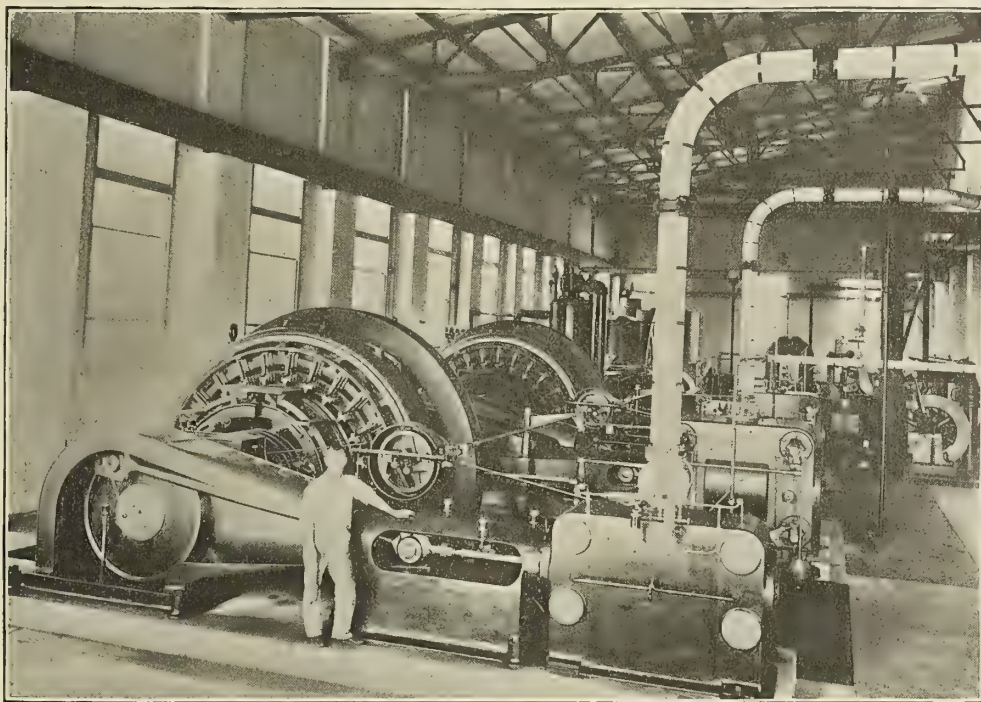
Opposite the office, which was described in the MARINE ENGINEERING of May, 1900, is the main entrance to the yard, and adjoining the gates is the time-keeper's office and office of the inspectors representing the companies for whom work is being done. Beyond this is the power house, built of brick with a steel truss roof, the inside of this roof being lined with 1-4 inch asbestos board. The house is divided equally by a central brick wall, the eastern half being the boiler room, and the western half the engine room. Steam at

160 pounds pressure is furnished by six Altman and Taylor boilers of 1,600 horse power, arranged in three pairs of two each. The stack rises from the center of the boiler house, and four new boilers are being installed on the southern side of the stack. The stack is 200 feet high by 8 feet 6 inches inside diameter, built of radial air cell bricks by the Alphons-Custodis Construction Company. Green economizers are used for heating feed water, and provision is made for using forced draft under the new boilers. Coal is brought to the boiler room in cars on a trestle, deposited in deep bins outside of the boiler room walls, and is shoveled from pockets directly into the furnaces.

In the engine room there are three separate plants, i. e., electric (both alternating and direct), com-

The air compressor plant at present consists of an Ingersoll-Sergeant compound steam and air compressor with a capacity of 4,000 cubic feet of free air per minute. This compressor is of the piston intake type with water inter-cooler, and at 75 revolutions compresses air to 110 pounds pressure. The cylinders of the compressor are 22 1-4 and 36 1-4 inches diameter, and those at the steam end, built by the Cooper-Corliss Company, are 22 and 44 inches in diameter, and all have a common stroke of 48 inches. The demands on this power are so great throughout the yard that this set is being duplicated.

Hydraulic power at 1,500 pounds pressure is supplied by two Barr pressure pumps with compound steam ends, and with outside packed plungers. The accumu-



VIEW IN POWER HOUSE WITH GENERATORS IN THE FOREGROUND.

pressed air and hydraulic, while overhead is a traveling crane of 15 tons lift.

The electric power is supplied by two 500 K. W. generators of the Westinghouse rotary converter type, each generator supplying both direct and alternate current. This latter is at 3,120 alternations and of two phases. The generators are each driven by a cross compound Rice and Sargeant Corliss engine, with cylinders 18 and 36 inches diameter by 42 inches stroke, making 120 revolutions per minute. Westinghouse rotary converters are used for exciting the fields, and to provide for the possibility of the generators losing their residual magnetism, a 50 K. W. generator is installed, direct connected to an Ames Iron Works engine.

Exhaust steam is led into the atmosphere, into the heating systems for the shops, or into a Nordburg duplex air pump and jet condenser of 5,000 horse power capacity.

lator for giving even pressure throughout the system is made by R. D. Wood and Co. Two service pumps supply water to the entire plant from 25 driven wells of 75 feet depth. They are both compound pumps, one made by Dean Brothers, and the other by the Snow Pump Company. The two boiler feed pumps are built by the Barr Pump Company, of the duplex compound plunger type. A Webster feed water heater is used in addition to the Green economizers above mentioned.

The three kinds of power are carried in a trench to the main buildings and are there distributed above ground through the shops.

The Fire Pump House, lying to the north of the Power House contains two Worthington underwriter pumps of 1,500 gallons capacity each, with cylinders 20 by 12 by 15 inches. Two 18 inch suction mains lead from the river, and either or both can be connected to the fire pumps or to the jet condenser in the Power House. The discharge is through cast iron

pipes to 28 three and four way hydrants of the independent outlet type placed throughout the yard. An automatic Fisher governor keeps the pressure in the system at 60 pounds, and this is raised to 100 or 125 pounds when an outlet is made in the line. A 3,000 gallon priming tank is located under the roof of the Pump House. There are eight hose houses at different central points of the yard, equipped with hose play pipes, according to the Factory Mutual Company's requirements. All buildings where wood or other combustibles are used are fitted throughout with a complete sprinkling system.

Let us now follow the processes of the material from the time it is received at the Yard to the time that it leaves in the form of the finished ship. In considering the arrangement of the buildings we find that

of them lead across the Plate Storage Shed. It was originally intended that all materials should be stored in this shed, but so much material is used that a large part of it is placed alongside the tracks. This material is handled by a locomotive crane. The gantry crane travels the length of the Plate Storage Shed and across the end of the Boiler, Angle and Plate Shops, and has two 10 ton trollies equipped with both chain hoists and electric magnets for lifting plates. This gantry can span two cars lengthwise.

Entering the Storage Shed, one obtains the first view of this immense inclosure, and is struck by the absence of the belting and shafting in all the buildings. Each machine has its independent electric motor and controller, or is operated by hydraulic or pneumatic power. As plates are required, they are picked



BLACKSMITH SHOP LOOKING NORTH, PLATE SHOP AT THE LEFT AND BOILER SHOP AT THE RIGHT.

they are laid out for the most rapid and economical handling of the work, and in no case is the material brought back over its path in passing through the shops. At the northern end of the Yard is the Plate Storage Shed, and at right angles to the Boiler, Plate and Angle Shops. These latter shops are covered by separate roofs, but there are no walls between them, so that all shops open into each other. The continuation of the Boiler Shop to the south is the Machine Shop, and the southern end of the Plate and Angle Shops opens into the Ship Sheds. In the first of these is an immense open basin in which the ships are fitted up, and in the remaining three are ground ways in which can be built three of the largest ships or six smaller ones.

Returning now to the northern end of the Yard, several receiving tracks enter at this point, and two

up by the gantry and carried to the straightening rolls at the end of this shed, and then transferred to the Plate Shop. At the end of this Shop are the laying-off tables, where the plate is marked according to the template made in the mold-loft, to which reference will be made later, and those plates which are to be bent are carried to the plate furnace at the end of the Shop. This furnace is 6 feet 6 inches broad and 28 feet long. In front of it is located a large slab, and above a 5 ton jib crane. At one side is a flanging machine to assist in working the plates. The deck and bulkhead plates are taken from the laying-off tables to the joggling rolls. In this class of work all outside strakes are joggled, thus avoiding the use of liners. Beyond these rolls are the punches, shears, drills and other tools. There are nine large punches, made by Wood and the New York Shipbuilding

Company. There are both rotary and hydraulic trimming shears and a 60 inch guillotine shear. A large milling scarphing machine, made by this company, is used to a large extent in scarphing plates where necessary. Two 30 foot William Sellers and Company

machine and two 6 inch radial drills. At the lower end of the shed are two rolls, one of which can handle a plate 27 feet broad, and the other is used for rolling mast plates.

Each of the large machines in this shop is served

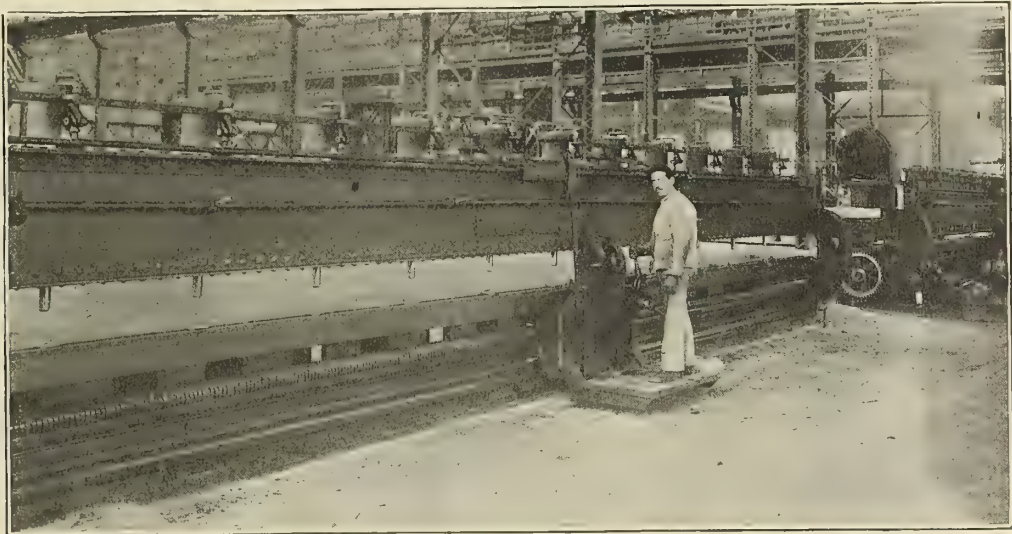
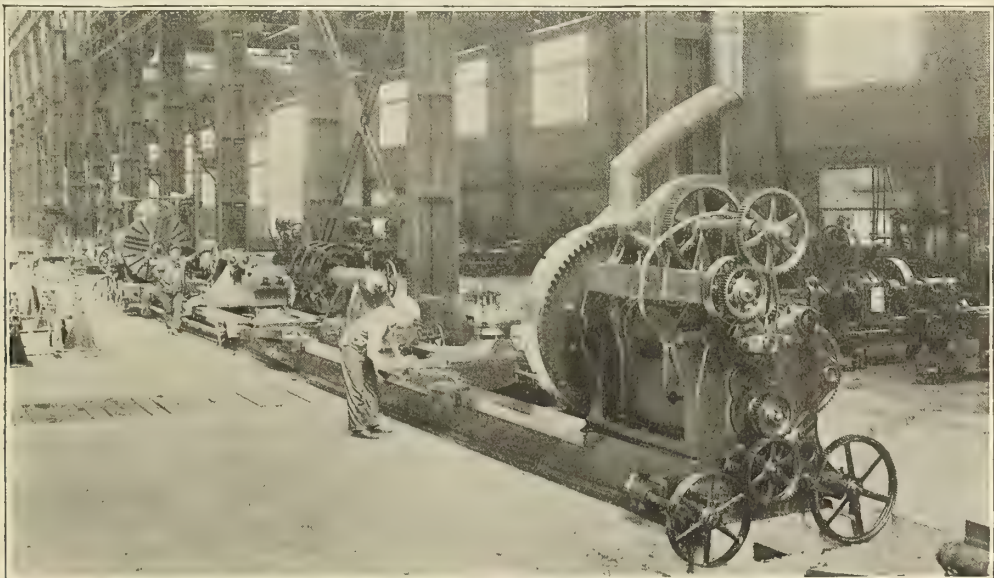


PLATE PLANER IN PLATE SHOP.

planers are used for planing the caulking edges of plates. Four countersinkers are carried on four double jointed jib cranes, each supplied with a 3 ton air hoist. Lightening holes up to 24 by 36 inches are cut by a

with a jib crane fitted with electric, air or hand power hoists. Overhead are two traveling cranes running the length of the shop, each equipped with two 5 ton trollies.



DOUBLE HEADED LATHE IN MACHINE SHOP.

Wood hydraulic punch, which may be used on all plates up to 1-2 inch in thickness. Several small punches for brackets and intercostals are at the lower end of the shop, also a horizontal punch, and a combined punch and shears which can be used for cutting timber holes. There is a Long and Allstatter notching

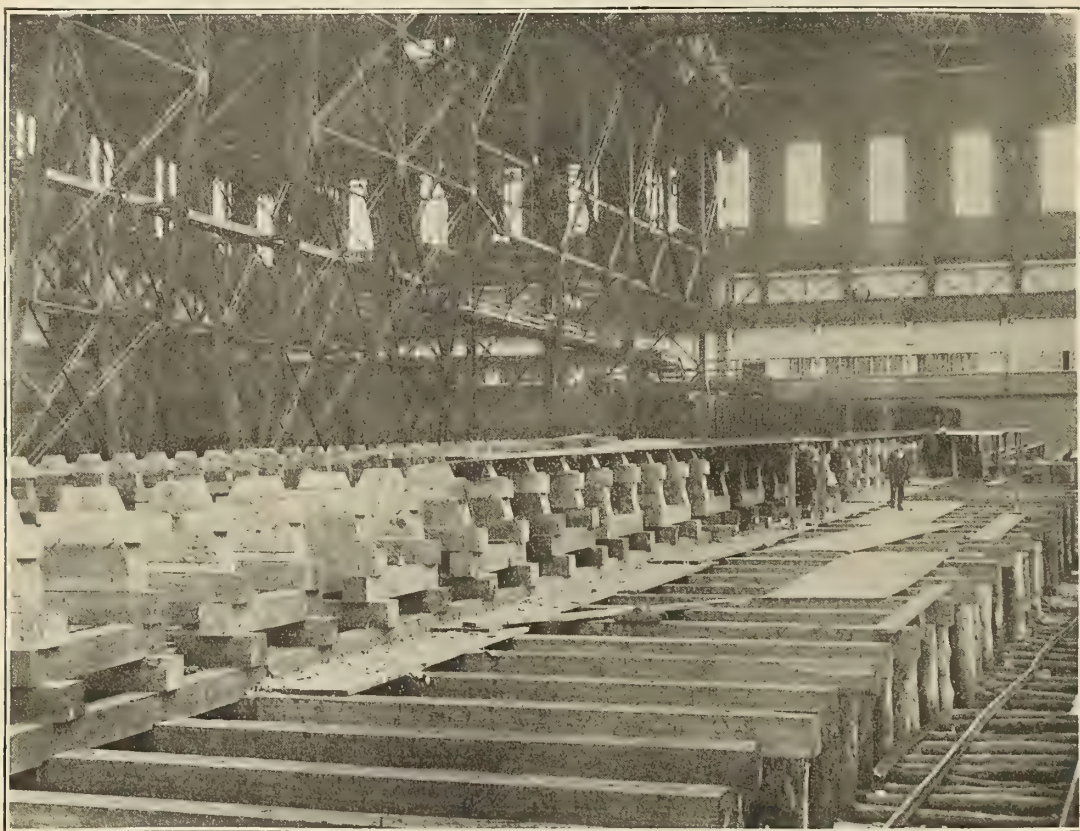
Retracing our steps, let us return to the end of the shop where we began and cross over to the Angle Shop, noting the various machines which are used in bending, punching and shearing the angles and shapes. There are two angle furnaces, one for taking a 60 foot angle, and the shorter one for handling a

30 foot angle. At the larger furnace is an iron slab 45 feet by 55 feet, and beside it is a Scotch beveling machine for beveling angles and channels. This machine is mounted on a truck and can be rolled before either furnace. Beside the smaller furnace is a setting press for bending the shape when cold to the exact template.

Material is handled in this shop by two traveling cranes, one with two 7 1-2 ton trollies, and the other with two 5 ton trollies. There are also three gantry cranes, each provided with five double jointed 1 ton jib cranes. Material is delivered from the Storage Shed to the furnaces or to the laying out tables. The long frames are taken from the bending slab at the furnace to a

portable punches are specially built roller tables for supporting the work. After it is assembled it is riveted by portable pneumatic riveters supported by pneumatic cranes. It is then picked up by one of three 10 ton gantries, which run on separate tracks, and is carried under the bows of the ships and stored until the time comes for it to be erected in place. As in the Plate Shop, and in fact every part of the Yard, the material is transferred each time by traveling cranes.

We now enter under the roof of the immense Ship Sheds, which extend from the wall of the machine shop towards and over the water. The open basin for fitting out the ships is in the first bay, thus allowing a big ship to enter the basin and be under roof. A pier 600



LAYING KEEL PLATE ON THE WAYS IN THE SHIP SHED. MACHINE SHOP WALL IN BACKGROUND.

second slab in the shed, where a special portable tool is used for setting them to the exact shape. As in the Plate Shop the tools here used are of the latest design for handling every class of work. Among them are a channel and I beam shears, two Newton cold saws (one mounted on a turntable for cutting at any angle), steel portable hydraulic punches, supported by jib cranes on the portable gantries mentioned above; electric driven gag punches for punching straight beams (built by the Shipyard); one Hilles and Jones portable punch and countersinking press, and a Long and Allstatter angle shears mounted on a turning table.

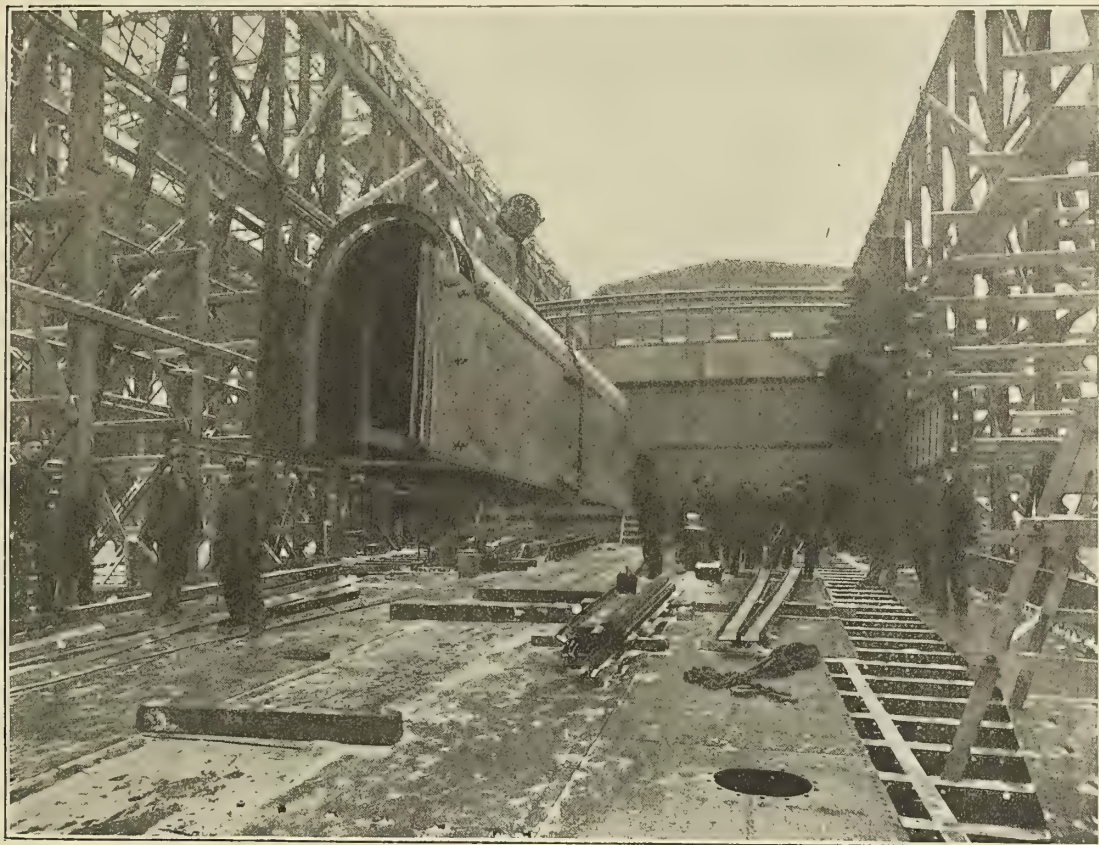
Material is stored on skids in the center of the shop and worked down to the end, where it is assembled with the plates from the Plate Shop. Under each of the

feet long extends from the entrance of the basin out into the river. The three adjoining bays are each capable of taking either one or two ground ways, one when a very large ship is to be laid down, and two when smaller ships are to be built. Thus six vessels of moderate beam can be laid down at the same time. There are two 10 ton traveling cranes for each of these building bays, the inner end of the cranes being supported by a runway suspended from the roof. These cranes are placed high enough to clear any ship while being built and fitted out after launching. The largest traveling crane in the works, of 100 tons capacity, is here located, and the numerous services to which it may be applied speak of the high engineering skill which characterizes the lay out of the entire plant. This immense crane can be used over any one of the four

bays. A transfer table running over the gallery of the Machine Shop transfers it with its load from one to another bay, and while on this table the crane can pick up, through hatches in the gallery floor, an engine or boiler from the assembling floor of the Machine Shop below and deliver it in place in the ship.

At present there are laid down ships of the following lengths: Two of 360 feet, one of 471 feet, and one of 490 feet. Besides these there are to be constructed one 490 feet and two 625 feet ships. Adjoining this great shed to the south, is an extra ways with wooden trestle and traveling cranes which will only be used when all the other ways are full. Pneumatic riveters, reamers, chip-

lay down the body plan on a marble slab. The offsets from this slab are given to the mold loftsmen who lay them off on a scribe board, and from this the templates of frames, etc., are made. The templates are marked for the spacing and size of rivets, the points of intersection of lines of keelsons and stringers, etc., and then handed to the foremen of the Plate and Angle Shops, who do the work strictly according to template. Only the bulkheads and decks are laid down on the main floor. This Loft is lighted by skylights, bringing the light from the north only. The requisite wood working tools, i. e., band saws, scarphing machines, channel and pin boring machines are found here.



VIEW OF TANK TOP OF HULL AND SHAFT ALLEY, OF A SHIP ON THE WAYS BEFORE THE COMPLETION OF THE SHIP SHEDS.

pers and caulkers are used throughout, but hand riveting is also employed. As the material is made from template it reaches the ship finished and ready for setting in place, and thus no fitting is required. This is a marked feature of this great shipyard, obviating as it does, the necessity of first carrying the work to the ship for fitting in place, and then carrying it back to the punches and shears.

The Mold Loft, where this system of templates is carried out, is located over the Plate Shop. At one end of the loft is a drawing room entirely distinct from the hull drawing room, where a large staff of draughtsmen are employed to make drawings for each form of plate and shape that goes into the ship. From the lines furnished by the hull drawing room these draughtsmen

The Joiner Shop is located on the water front and to the north of the ways. The lumber is brought in vessels. That for outside work is stored in the open and that for inside work is stored in the Lumber Shed. A transfer table is used for carrying cars of lumber from different tracks in the shed or to the Dry Kiln. The Joiner Shop opposite is equipped throughout with cut-off, re-saw and rip saws, morticing and drilling machines, double beveled band saws, matcher and four side planers. The sawdust is removed by the exhaust system. Each machine is independently driven, except some of the smaller machines, which are driven in groups. On the second story are benches for the lighter class of work. At one end of this floor is a separate room for grinding all saws and knives used

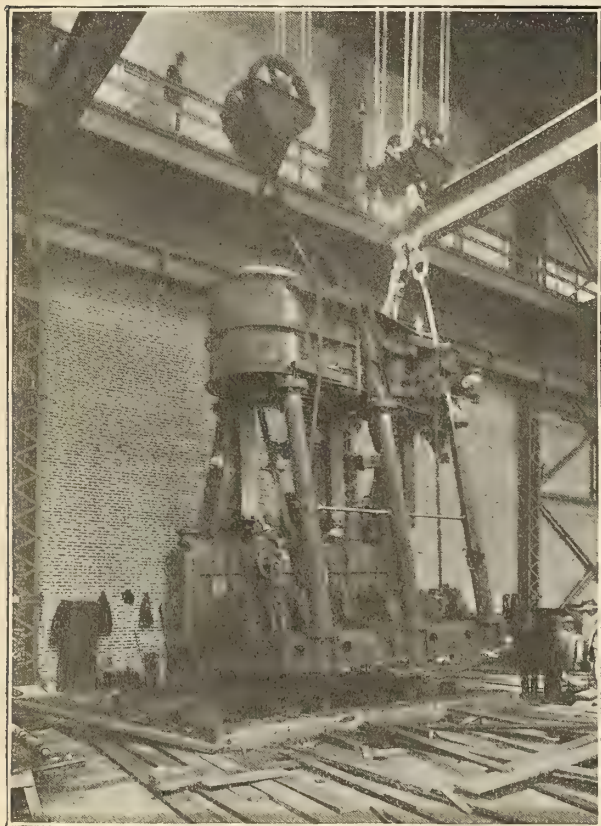
in this Shop. Both floors are protected against fire by a sprinkling system.

Entering the Machine Shop from the southern end we will follow the course of the castings and forgings which go into equipping the ship and building the engines. This shop, as previously stated, is a continuation of the boiler shop. There are three bays, and one lean-to to the east. The main bay is equipped with two traveling cranes, of which one crane is of 10 tons capacity and the other of 30 tons capacity, with a 5 ton auxiliary hoist.

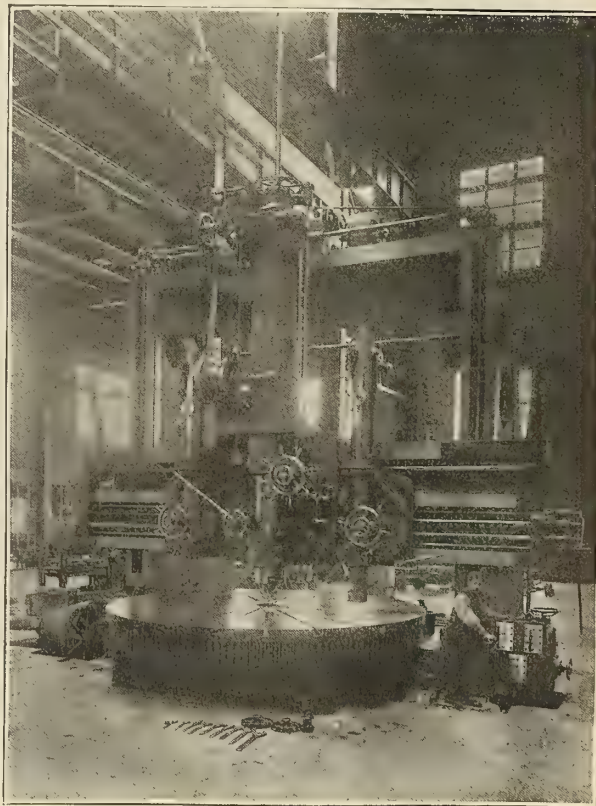
The lean-to contains the brass or duplicating shop, a storage and forge shop, a tool room and tool machine room. The east bay has a 7 1-2 ton extension crane, and the west bay a crane of the same capacity,

for facing flanges and drills. The heating system for this building is installed by B. F. Sturtevant Company, and consists of four fans which draw air around nests of coils supplied with steam from the exhaust from the Power House, the air being distributed through large pipes.

On the main floor of the Machine Shop is found the largest and most complete equipment of tools of all sizes and for various purposes. First comes a 16 foot vertical Niles boring mill fitted with three boring arms, two for use when the work is revolving and one for use when the work is stationary. Next is a large Sellers drilling, boring and milling machine with 8 inch spindle. This machine has been equipped with steel scales and verniers for placing the work on the



ENGINE ERECTED IN MACHINE SHOP READY TO BE LIFTED BY 100 TON CRANE.



SIXTEEN FOOT BORING MILL IN THE MACHINE SHOP.

double extension. These extensions are girders which can be run out from underneath the cranes for picking up material in the main bay between the columns and delivering it to the side bays.

Over the east gallery is a miscellaneous storeroom and electric repair shop, with lathes, shapers, drill presses, forges, hack saws, etc., and overhead runs a 7 1-2 ton crane with hoist sufficiently long for taking material from the ground floor through hatches in the gallery.

Over the west gallery is a 5 ton crane serving the pipe shop, which is here located. There is also a 25 ton crane serving the erection floor of the Machine Shop through open hatches in this gallery. This shop is thoroughly equipped with pipe cutting and threading machines, lathes, drill presses and grinding machines

table and measuring it in each direction. There are two band saws for cutting steel, such as cutting out excentric straps, etc., built by the Noble and Lund Company, of England. There is a horizontal milling machine from Bement-Miles and Company, two Newton milling machines, an open side planer, 72 by 28 inches, built by Dietrick and Harvey, a Betts planer 96 inches by 96 inches by 36 feet, an Index drill, two double headed lathes, one 48 inches by 60 feet, the other 60 inches by 60 feet, two Niles horizontal boring and milling machines, which can be used parallel so as to finish a housing complete with but one setting on the bed. Besides these special machines there are many planers, lathes, drills, boring and milling machines, and each and every machine has its separate motor and controller. The erecting floor in the west

gallery is served by two gallery cranes and also by the 100 ton crane, which was mentioned above. All material is weighed rough and when finished. Railroad tracks run across the shop at the northern end

rolled by the straightening rolls and delivered to the Boiler Department, where they are laid off preparatory to being taken to the punches or shears or to the flanging machines. Two bays are devoted to this Shop.



MACHINE SHOP, LOOKING NORTH FROM THE GALLERY. THE BOILER SHOP IS ON FURTHER SIDE OF LOW PARTITION.

and into the shop at the southern end.

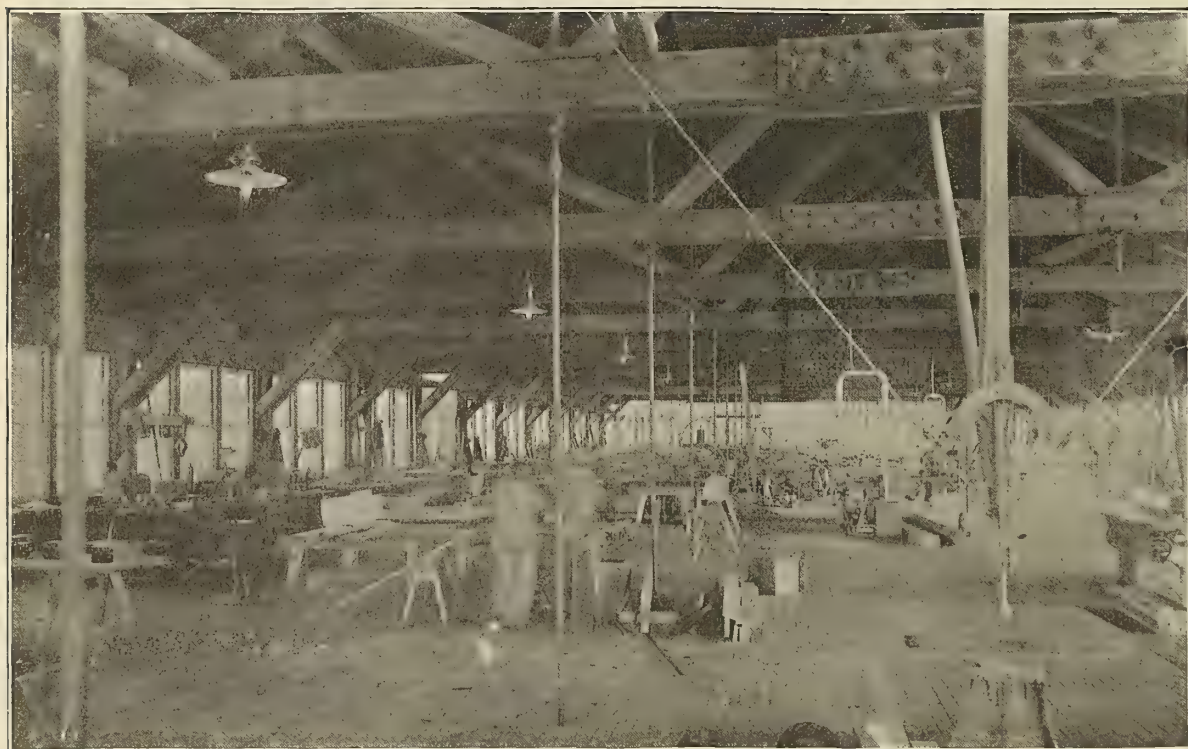
Passing through a door in a low partition at the southern end of the Machine Shop we enter the Boiler Shop. The boiler plates are taken from the plate rack under the gantry crane at the northern end of the shop,

The central bay is served by a 60 ton and a 10 ton crane, and the side bay by a 7 1-2 ton extension crane, and by a crane of the same capacity to be used over the flanging furnace which is at the northern extremity of the shop. The 60 ton crane and the one

over the bending furnace can be operated from the floor when desired. The plates for the heads of the boilers are taken to the northern end of the shop, the rims heated and then flanged in a 160 ton hydraulic flanging machine. This machine is also equipped with dies for upsetting stay bolts, flanging furnace mouths, making manhole covers and dogs. The plates are then put in an annealing furnace, and straightened on a slab in front of same. The scarphs of the flanges of the boiler head plates are made by hand at a nearby forge. The shell plates are rolled in a vertical 10 foot roll, capable of handling plates up to 1 1-2 inches thick. There is a 28 foot planing machine, and an elliptical and circular boring machine of English make. The plates are then mounted on a multiple vertical

Blacksmith Shop, equipped with steam hammers and forges of various sizes, to which are attached exhaust hoods. In the gallery over the Blacksmith Shop are the light plate and copper shops, the former for making uptakes, stacks, water tanks, etc., and both are equipped with modern machinery and served by a 7 1-2 ton crane. A drop forging plant is being installed in the Blacksmith Shop consisting of one 3,000 pound, one 1,100 pound, and two 800 pound drop hammers with Bliss trimming presses, also an Acme bolt and nut machine is to be installed for making rivets and bolts. Rivet bins are placed in the wall and open directly opposite the riveting machines of the Angle Shop.

In the gallery of the west bay of the Machine Shop is the hull department tool and storeroom. This opens



SECOND STORY OF THE JOINER SHOP.

boiler drill built by the New York Shipbuilding Company. This machine has three columns, each of which has a saddle with four drill spindles arranged so that three drills on each saddle can be placed in either a horizontal or vertical plane. Thus 9 holes can be drilled at a time. This machine will handle boilers up to 18 feet diameter. Among the other machinery in this shop are four 6 foot Pond radial drills, two Wood shears for trimming 1 1-2 inch plates, one Sellers 150 ton bull riveter, two Wood hydraulic riveters carried on jib cranes, one riveter being 150 tons and the other 90 tons, and both being used for riveting furnace mouths. Besides these there are Sellers rolls, horizontal punches, countersinking machines and a complete equipment of pneumatic tools. Special trucks for carrying boilers up to 60 tons weight run on tracks extending lengthwise through this building.

In the bay to the west of the Boiler Shop is the

to the west on a platform leading directly to the staging of the building ways.

A new building is being erected at the receiving tracks for the Pattern Shop and pattern storage. Patterns are made at present in the Joiner Shop. Near by is a modern brick Oil House, where barrels of oil can be stored or quickly emptied into large receiving tanks.

On the water front is a building containing the paint shop and rigging loft. In the former are paint mixers and putty grinders and in the latter shop are stored tackle and rigging necessary for use in the Yard.

The traveling cranes are made by William Sellers and Company, Pawling and Harnischfeger, the Niles-Bement Pond Company, and the New York Shipbuilding Company. Westinghouse Type C motors for up to 60 tons weight run on tracks extending lengthwise through this building.

Such complete facilities for rapidly and economically

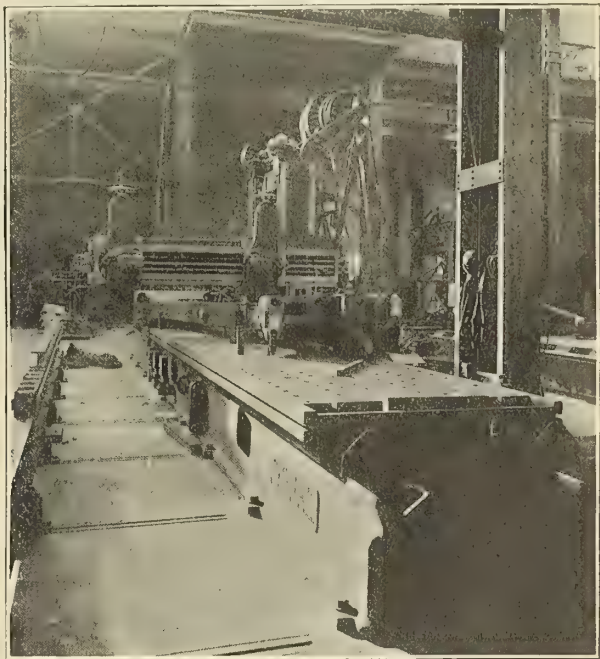
handling the work of building ships and marine machinery are to be found in no other yard. The usual delays met with in the hull department on account of inclement weather will not occur at this yard, as the work is performed under cover from start to finish, and with the extensive equipment described above, the time required to build and completely equip ships of all types will be reduced to a minimum.

The naval architects and engineers of this country and abroad who have visited these great works have been unanimous in voicing the opinion that here is found the greatest shipbuilding plant of the age.

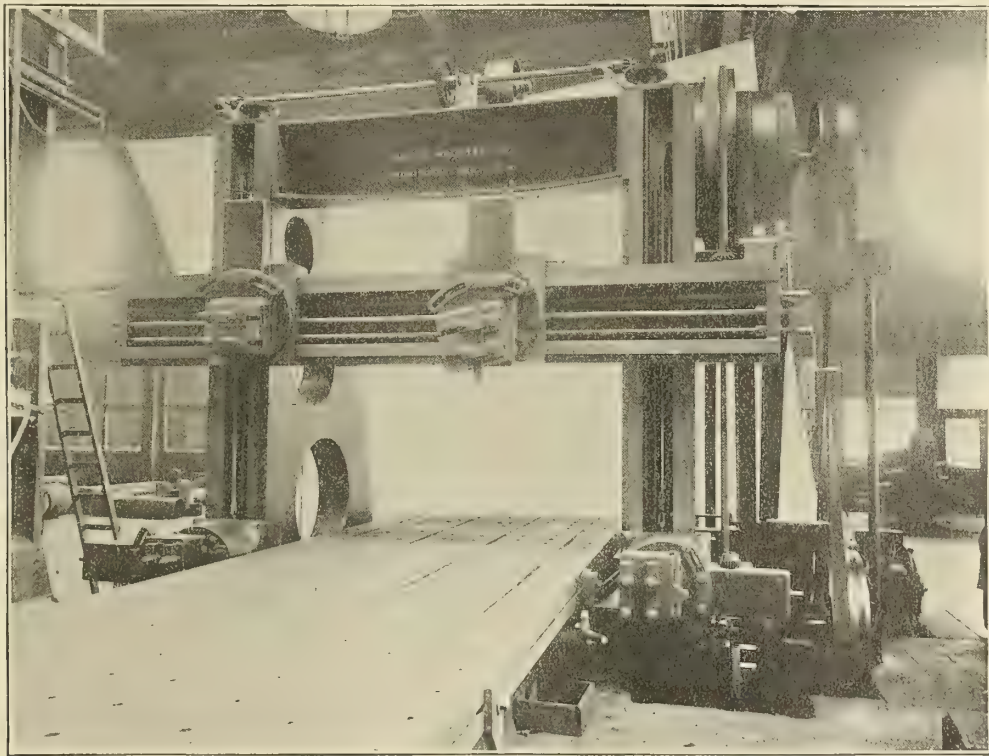
Explosion of Gasolene Launches.

Several explosions on gasolene launches have occurred during the past season. Among these one of the most interesting was that on the launch *Kid*, described in a letter addressed to the *Rudder*. This launch is 52 feet long, 10 feet 6 inches beam, and has a 12-foot deck forward, the gasolene being located under the deck. The deck house includes pilot house, cabin and engine room. The boat was equipped with a storage battery electric light plant, and the owner had taken the usual precaution to remove all fuses from the switch board. He, however, overlooked one which was attached to the batteries in the cabin floor. The owner and the builder of the engine were sitting in the engine room, and the latter in rising from his seat struck the switches on the switch board, causing a short circuit, which blew out the fuse beneath the

room and cabin. The two men were saved by the switch board falling on them, thereby protecting them somewhat from the fire.



OPEN SIDE PLANER.



PLANER WITH BED 8 FEET BY 36 FEET.

cabin floor. The gases had filled the cabin by entering through the pilot house door, and were ignited by the short circuit. The resulting explosion blew out both sides, the roof, and partition between the engine

The conclusion drawn is, that while filling a tank with gasolene, open all windows, draw all fuses, and keep outside until the gases have escaped. In this case, the tank itself did not explode.

NINTH GENERAL MEETING OF THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

The ninth annual meeting of the American Society of Naval Architects and Marine Engineers was held on Thursday and Friday, November 14 and 15, 1901, in the auditorium of the American Society of Mechanical Engineers, No. 12 West Thirty-first street, New York City.

On the preceding day the council had met and disposed of the business properly coming before it. Among other features an invitation was presented from the *Schiffbautechnische Gesellschaft*, inviting members of this society to attend the next meeting of their society during the coming summer. It was ordered that the invitation be received and suitably acknowledged with the assurance that such members as might find it possible to attend would be suitably recommended to their courtesy.

Another feature was the report of the committee on the prize competition for the best paper on methods of engine balancing. The committee reported that there were two papers of unusual excellence, one of which they had recommended for the prize, and they asked that the council appropriate a second prize of \$50 for the second paper. This recommendation was upon motion adopted by the council.

In this same connection the council adopted a resolution looking toward the offering of annual prizes, details of which will be made public at a later date.

The first regular session was called to order at 10.30 a. m. on Thursday, by Secretary Capps, who stated that in the absence of the president it was necessary to elect a chairman, and requested that nominations be made. On motion of Mr. E. Platt Stratton, Mr. Stevenson Taylor was called to the chair.

The first business was the report of the secretary-treasurer, which was received and adopted.

The list of applicants to admission to the various grades of the society had been passed upon the previous day by the council. This list was then read by the secretary as the recommendation of the council for election. Upon motion, the recommendation was adopted and the list of names was declared unanimously elected. This list is as follows:—

Members 25.—Roland Allwork, Inspecting Engineer, Panama R. R. S. S. Line, care of Panama R. R. Co., 24 State street, New York; John Millington Blankenship, Assistant Superintendent Merchants and Miners Transportation Co., Baltimore, Md.; Jacob Brauchli, Inspecting Draughtsman, office of Superintending Engineer, U. S. N., Newport News S. B. & D. D. Co., Newport News, Va.; William Ledyard Cathcart, Adjunct Professor, Mech. Engineering, Columbia University, New York; William Brown Collison, First Class Draughtsman, C. & R. Dept., Navy Yard, New York; Bowdoin Bradlee Crowninshield, Naval Architect, 31 State street, Boston, Mass.; Robert Everett Hall, Secretary New York Steam Fitting Co., 137 Elm street, New York; Urban Harvey, Second Assistant Engineer Revenue Cutter Service, Division Revenue Cutter Service, Treasury Dept., Washington, D. C.; Vincente L. Legarda, Naval Architect, Union Iron

Works, San Francisco, Cal.; Philip Leventhal, Designing Engineer and Chief Draughtsman, Gardner & Cox, 1 Broadway, New York; Patrick H. McGiehan, Draughtsman, C. & R. Dept., Navy Yard, New York, 502 Jefferson avenue, Brooklyn, N. Y.; Stewart H. Moore, United States Local Inspector of Boilers, 2 River street, Chicago, Ill.; 6801 Perry avenue, Chicago, Ill.; Yasnichi Sugitani, Ship Yard Manager Mitsu Bishi Dock Yards and Engine Works, Nagasaki, Japan; Paul Augustine Talbot, Chief Hull Draughtsman, Wm. R. Trigg Co., Richmond, Va.; Frank Van Vleck, Asst. Superintending Engineer, U. S. Army Transport Service, 36 New Montgomery street, San Francisco, Cal.; Harry Wheeler, Superintendent, Atlas S. S. Co., Pier 44, North River, New York; Nagakato Yamamoto, Chief Draughtsman, Ship Dept., Mitsu Bishi Dock Yards and Engine Works, Nagasaki, Japan; C. C. Bowers, Superintending Engineer, Crescent Shipyards, Elizabeth, N. J.; Daniel Douglass Boyd Brown, Leading Hull Draughtsman, Wm. R. Trigg Co., Richmond, Va.; Goold H. Bull, Professor of Marine Engineering, Webb's Academy, Fordham Heights, N. Y.; Samuel Shearer Caskey, Superintendent of Machinery Construction, Harlan and Hollingsworth Co., Wilmington, Del.; Henry Robert Curwen, Chief Draughtsman, Crescent Shipyards, Elizabeth, N. J.; Robert H. Fraser, Engineer Surveyor, American Record, Dorchester, Mass.; Howard C. Higgins, Superintending Engineer, Old Dominion Steamship Co., New York; Ernest A. Perham, Leading Draughtsman, Hull Department, Fore River S. and E. Co., Quincy, Mass.

Promotion from Associate to Member 7.—Wm. G. Groesbeck, Asst. Naval Constructor, U. S. N., Wm. R. Trigg Co., Richmond, Va.; Joseph Ezekiel McDonald, Asst. Naval Constructor, U. S. N., Navy Yard, Mare Island, Cal.; Henry H. Schulze, Leading Draughtsman, in charge of merchant work, Wm. R. Trigg Co., Richmond, Va.; Arthur P. Allen, Designer and Supervising Draughtsman, Moran Bros. Co., Seattle, Wash.; George C. Cook, Naval Architect and Engineer, 15-25 Whitehall street, New York; Wm. Carr Nickum, Draughtsman, Wm. Cramp and Sons' S. and E. B. Co., Philadelphia, Pa.; Joseph B. Rowen, Assistant in Charge of mold loft, Wm. Cramp and Sons' S. and E. B. Co., Philadelphia, Pa.

Associates 58.—Herbert Lincoln Aldrich, Publisher and Manager of Marine Engineering, 309 Broadway, New York; Elliott Ivar Gamborg Andresen, Asst. Manager to Holzapfel's Composition Co., 18 Broadway, New York; George Harold Bates, Chief Engineer, Burlee Dry Dock Co., Port Richmond, S. I., Box 40, Crawford, N. J.; Guy Aloysius Bissett, Asst. Naval Constructor, U. S. N., Navy Yard, Boston, Mass.; Harry Brown Bloomsburg, Draughtsman, Engine Dept., Newport News S. B. and D. D. Co., Newport News, Va.; Walter William Clark, Engine Draughtsman, Neafie and Levy S. and E. B. Co., Philadelphia, Pa., 1322 Stiles street, Philadelphia, Pa.; Alexis Crane, New York Manager and Special Expert Ship Equipment, for Art Metal Construction Co., 346

Broadway, New York; Frank H. Cross, Hull Draughtsman, Wm. R. Trigg Co., Richmond, Va.; Karl Erik Delin, Draughtsman, Hull Dept., Newport News S. B. and D. D. Co., Newport News, Va.; Thomas Murritt Dick, Ensign, U. S. N. (retired), Professor of Mechanical Engineering, A. and M. College, Raleigh, N. C.; Edmund Baker Edwards, Draughtsman, Fore River Ship and Engine Co., Quincy, Mass.; Harvey D. Goulder, Proctor in Admiralty, 816 Perry-Payne building, Cleveland, Ohio; James Ringold Guy, Hull Draughtsman, Wm. R. Trigg Co., Richmond, Va.; O. P. Hagstrom, Leading Draughtsman, Newport News S. B. and D. D. Co., Newport News, Va., P. O. Box 628, Newport News, Va.; Bernard Hedstrom, Hull Draughtsman, Moran Brothers Co., Seattle, Wash., P. O. Box 873, Seattle, Wash.; Gabriel Hofgaard, Ship Draughtsman, Wm. Cramp and Sons' S. and E. B. Co., Philadelphia, Pa.; Philip Lamson, Draughtsman, Hull Dept., Newport News S. B. and D. D. Co., Newport News, Va.; Frank Provost Larkin, Draughtsman, Engineering Dept., Newport News S. B. and D. D. Co., Newport News, Va., 224 Forty-ninth street, Newport News, Va.; Newbury D. Lawton, 40 Wall street, New York; Curtis Darling Mabry, Hull and Calculating Draughtsman, Gardner and Cox, 1 Broadway, N. Y., 226 West Lincoln avenue, Mt. Vernon, New York; Lewis Albert Mason, Chief Hull Draughtsman, Burlee Dry Dock Co., Port Richmond, S. I.; Joseph McCreery, Senior Member, Joseph McCreery and Sons, Toledo, Ohio; Wm. Cullen McGowan, Asst. Draughtsman, Wm. R. Trigg Co., Richmond, Va.; Charles C. Moss, Ship Draughtsman, Wm. R. Trigg Co., Richmond, Va.; Leonard Drake Norsworthy, Ship Draughtsman, Bath Iron Works, Bath, Maine, 146 Oak street, Bath, Me.; Charles Thomas Perkins, Draughtsman, C. and R. Dept., Navy Yard, Portsmouth, N. H.; Harry Ball Stilz, Ship Draughtsman, Naval Constructor's Office, Bath Iron Works, Bath, Me.; Horace Holden Thayer, Jr., Estimating Draughtsman, Harlan and Hollingsworth Co., Wilmington, Del., 806 Adams street, Wilmington, Del.; Henry M. Toch, Manufacturer of Marine Cements and Ship Bottom Paints, 472 West Broadway, N. Y.; Wm. Robertson Trigg, President Wm. R. Trigg Co., and V. P. Richmond Locomotive Works, Richmond, Va.; Charles J. Weinz, Superintendent Insulating Construction, H. W. Johns Mfg. Co., 100 William street, New York; Charles Cameron West, Draughtsman, Hull Dept., Chicago Shipbuilding Co., Chicago, Ill.; 577 East Division street, Chicago, Ill.; Chauncey Gilbert Whiton, Treasurer and Agent, The New Bedford, Martha's Vineyard and Nantucket Steamboat Co., 7 Commercial street, New Bedford, Mass.; Charles Franklin Willard, Scientific Dept., Eastern Shipbuilding Co., New London, Conn., P. O. Box 336 Groton, Conn.; Henry Williams, Asst. Naval Constructor, U. S. N., Navy Yard, New York; Oscar Fredrik Witt, Hull Draughtsman, Newport News, S. B. and D. D. Co., Newport News, Va.; Robert Kemp Wright, Master of Steam Yacht *Nourmahal*, New York Yacht Club, Forty-fourth street, New York; John F. Bruton, Quartermaster Machinist, C. and R. Department, Navy Yard, New York; Lieut. Lloyd Horwitz Chandler, U. S. N., Navy Department, Washing-

ton; John P. Chase, Draughtsman, Fore River S. and E. Co., Quincy, Mass.; Daniel Cox, Draughtsman, Hull Department, Neafie and Levy S. and E. B. Co., Philadelphia, Pa.; Frederick Pomeroy Hall, Hull Draughtsman, Designing Department, Holland Torpedo Boat Co., Elizabeth, N. J.; Frederick Hepburn, Leading Draughtsman, New York Shipbuilding Co., Camden, N. J.; Charles E. Houston, Hull Draughtsman, Neafie and Levy S. and E. B. Co., Philadelphia, Pa.; Howard H. Hummel, Student of Naval Architect, Webb's Academy, Fordham Heights, N. Y.; Wm. Elbert Jackson, Student of Naval Architecture and Marine Engineering, Webb's Academy, Fordham Heights, N. Y.; Jacob Katzenstein, Superintendent of L. Katzenstein and Co., 358 West street, New York; James G. Lindsay, Senior Member of Jas. G. Lindsay and Co., Philadelphia, Pa.; Walter Henry Millard, Designing Department, Holland Torpedo Boat Co., Elizabeth, N. J.; Alfred Wynn Minuse, Student of Naval Architecture, Webb's Academy, Fordham Heights, N. Y.; Axel E. Petre, General Manager Midvale Steel Co., Philadelphia, Pa.; Lieutenant Walfrid Van Ness Powelson, U. S. N., Equipment Officer, Navy Yard, New York; Walter H. Rogers, Leading Draughtsman, Hull Construction, Wm. Cramp and Sons' S. and E. B. Co., Philadelphia, Pa.; Edson B. Schock, Superintending Construction, Holland Torpedo Boat Co., Elizabeth, N. J.; Watson C. Schriener, Student of Naval Architecture, Webb's Academy, Fordham Heights, N. Y.; Townsend J. Smith, Hull Draughtsman, T. S. Marvel and Co., Newburgh, N. Y.; Thomas A. Watson, President Fore River S. and E. Co., Quincy, Mass.; Wm. I. Wyman, Draughtsman, C. and R. Department, Navy Yard, Boston, Mass.

Promotion from Junior Membership to Membership 5.—Thomas M. Cornbrooks, Ship Draughtsman, Hull Dept., Maryland Steel Co., Sparrows Point, Md.; Alpheus Appleton Packard, in charge of Ordering Dept., New York Shipbuilding Co., Camden, N. J.; Edwin S. Alexander, Inspector, Newport News S. B. and D. D. Co., Newport News, Va.; Ernest I. Cornbrooks, Maryland Steel Co., Sparrows Point, Md.; Walter S. Leland, Instructor in Naval Architecture, Mass. Inst. Tech., Boston, Mass.

Junior 22.—Henry Douglas Bacon, Draughtsman, Hull Dept. N. Y. Shipbuilding Co., Camden, N. J.; 115 Evergreen avenue, Woodbury, N. Y.; Alex. de Brettville, Draughtsman, Fulton Engineering and Shipbuilding Works, San Francisco, Cal.; Emil Amandus Briner, M. E., Draughtsman, Neafie and Levy S. and E. B. Co., 1917 Girard avenue, Philadelphia, Pa.; James Alexander Crawford, Asst. Draughtsman, Naval Constructor's Office, Union Iron Works, San Francisco, Cal.; 414 Nineteenth street, Oakland, Cal.; Hugh Dougherty, C and R. Dept., Navy Yard, New York, 74 Manhattan avenue, Jersey City Heights, N. J.; Charles Henry Godbold, Jr., Draftsman, U. S. N., Union Iron Works, San Francisco, Cal., 2040 Clinton avenue, Alameda, Cal.; Francis Granger Hall, Jr., Asst. Manager, Naval Electric Co., 95 Liberty street, N. Y.; John G. Kreer, Engineer, with Purdy and Henderson, 539 La Salle street, Chicago, Ill.; George Barrell Moody, Government Draughtsman, Bath Iron

Works, Bath, Me.; Walter Augustine Read, Asst. Draughtsman, C. and R. Dept., Navy Yard, N. Y., 95 Madison street, Brooklyn, N. Y.; Arthur Lindville Terry, Jr., Draughtsman, Hull Dept., New York Shipbuilding Co., Camden, N. J.; Roger Willard Wright, Asst. Draughtsman, U. S. Inspector of Machinery, Bath Iron Works, Bath, Me.; Charles C. Brush, Draughtsman, Neafie and Levy S. and E. B. Co., Philadelphia, Pa.; W. Benson Caswell, Draughtsman, Neafie and Levy S. and E. B. Co., Philadelphia, Pa.; Herbert Henshaw Christopherson, Student of Naval Architecture, Webb's Academy, Fordham Heights, N. Y.; Matthews Erastus Davis, Assistant Foreman of Ships, New York Shipbuilding Co., Camden, N. J.; Harley Hichborn Grogan, Assistant Draughtsman, Office of Superintending Constructor, Fore River S. and E. Co., Quincy, Mass.; Robert Stanley Haight, Assistant to Superintending Engineer, Old Dominion S. S. Co., New York; Wm. Franklin Hussey, Hull Draughtsman, Neafie and Levy S. and E. B. Co., Philadelphia, Pa.; Edwin E. Mager, Hull Draughtsman, Neafie and Levy S. and E. B. Co., Philadelphia, Pa.; Samuel Deems McComb, Draughtsman, Hull Department, Townsend and Downey Shipbuilding and Repair Co., Shooters Island, N. Y.; Charles Albert North, Ship Draughtsman, Townsend and Downey Shipbuilding and Repair Co., Shooters Island, N. Y.

The secretary also reported that the council recommended the re-election of the old officers with the promotion of Rear Admiral Bowles from member of council to vice president. By the resignation, owing to ill health, of Mr. H. Taylor Gause as member of council and executive committee, and by the death of Rear Admiral Bunce, two vacancies were made in the council and the council recommended that these be filled by the election of Naval Constructor D. W. Taylor and Professor Ira N. Hollis, of Harvard University. These recommendations of the council were upon motion unanimously adopted by the meeting: President, Clement A. Griscom; vice presidents, Francis T. Bowles, Charles H. Cramp, F. L. Fernald, Philip Hichborn, Chas. H. Loring, George W. Melville, George W. Quintard, William T. Sampson, Irving M. Scott, Edwin A. Stevens; members and associate members of council, W. Irving Babcock, Washington L. Capps, French E. Chadwick, J. E. Denton, George W. Dickie, W. F. Durand, Edward Farmer, Nathaniel G. Herreshoff, Ira N. Hollis, William H. Jacques, John C. Kafer, Frank B. King, Frank E. Kirby, Walter M. McFarland, Jacob W. Miller, Lewis Nixon, Cecil H. Peabody, Walter A. Post, Harrington Putnam, Horace See, E. Platt Stratton, Stevenson Taylor, David W. Taylor, George E. Weed; executive committee, Washington L. Capps, ex-officio, Clement A. Griscom, ex-officio, Lewis Nixon, Harrington Putnam, Edwin A. Stevens; secretary and treasurer, Washington L. Capps.

FIRST TECHNICAL SESSION.

The proceedings of the session were opened by the announcement of the first paper on the program. In the absence of the author, and at his request, the paper was read by the chairman.

TRIAL OF SPEED BETWEEN THE STEAMERS CITY OF ERIE AND TASHMOO.

BY FRANK E. KIRBY, ESQ., MEMBER OF COUNCIL.

Abstract.

This paper discusses in detail the speed trial between these two steamers, held on June 4, 1901, an account of which was given in MARINE ENGINEERING for July, 1901. The ships are described in detail, and drawings are given of their lines. The leading particulars of the machinery for each ship are then given, together with the data for the run. Due to leaky snifting valves no indicator cards were taken on the *Tashmoo*. On the *Erie* cards were taken, samples of which are reproduced in the paper. A graphical chart or log is also given showing the variation of depth of water, speed, slip and indicated horse power throughout the run.

DISCUSSION.

THE CHAIRMAN: Mr. Kirby has sent photographs of the race, which are very interesting and which I will leave here if you wish to look at them. He has also sent the original chart of this log, which was in the pilot house of the *City of Erie*, showing the speed at all times, and that is very interesting. The paper is now open for discussion.

MR. ANDREW FLETCHER, JR., stated that the photographs accompanying the paper and showing a great number of people on the *Erie* might give a false impression regarding the conditions on the boat during the race. The life boats were taken off, the boat davits were trailed aft, regular colors were off and a "fifteen cent" flag was flown. It was also much the same on the *Tashmoo*. All windows on both boats were closed, and the people were practically locked in. The purpose was to strip the boats down to their racing condition.

MR. WILLIAM H. FLETCHER: I think, Mr. Chairman, the thanks of the Society are due to Mr. Kirby for his paper, which, it seems to me, is an able presentation of the matter, and contains a great deal of valuable information. The remarks of my cousin just now in regard to being locked in might be supplemented by saying that we were not even allowed to go out of doors without a pass. But while we were stripped on the *City of Erie*—I say that because we were all on her and most interested in her—we did not put any weight ashore. They had to put weight on board. I think one of the most striking things to me in the paper was the falling off in speed of the *City of Erie* at the time when we were off Fairport. I was up in the Captain's room with you, Mr. Chairman, at the time, if you remember. My principal occupation was watching this speed curve. She suddenly dropped off a mile an hour on that indicator, and when you went to the engine room I went out to the side of the boat and saw this wave that is usual in shallow water following the boat. When we consider that according to the chart, at the time this drop for a mile an hour occurred, there was, according to the chart, about six fathoms under this boat drawing ten feet and a fraction, it is rather remarkable that she would feel the bottom to that extent with so much water under her. The other boat, according to the chart and according to

the distance she was away from our boat, as I remember it, had nearly two fathoms more water under her at the time than we did. I thought just before we reached Fairport, as nearly as I could judge from watching the position of the two boats, that we were as far ahead of her at that time as we were at the finish, although we crossed the line slightly in advance. That, however, was due to our gathering way more quickly than she did, because we started our boat from the drop of the flag. It was a magnificent race. Nothing could be conducted more fairly, and no more precautions could be taken to make the race sure and absolute than were taken in that case.

MR. W. IRVING BABCOCK: The general impression on the Lakes at the time of that race was that while the *City of Erie* was stripped, the *Tashmoo* was not. I am a little surprised to hear Mr. Fletcher say that both boats were properly stripped. I was not there; I only know what I heard up on the Lakes—that the *Tashmoo* was beaten because they did not take proper precautions. Another thing that I notice is that the air pressure on the *Erie* is given as five inches at the maximum, which is pretty high. Was there any change by the use of that, or were there any unusual means taken to get vacuum?

MR. W. H. FLETCHER: I would like to answer Mr. Babcock in that particular. I would say that Mr. Andrew Fletcher and I arrived in Cleveland about 7.30 in the morning. We went down on board the boat, the *Erie*, a little before 9 o'clock. She was then discharging some of her freight. There was absolutely no preparation made as far as the boat was concerned except to take the life boats from above and put them on the main deck; they were not put ashore. There was nothing done around or about the engine, as far as I could discern—I think all will bear me out who were on board—except that they had good coal. That was evident. There is no question about the vacuum. I think if Mr. Babcock would read between the lines he would see some reason why cards could not be taken. Another thing that I noticed—I only bring this out for discussion now as long as you mentioned it—it seemed to me from the *Erie* that the *Tashmoo* would come up on us and drop back, come up and drop back. Of course, I was not on the *Tashmoo*. I had never seen her except at a distance, but I had the impression at that time that they were using the pass-over up to the point when she would begin to lose vacuum, and then shut it off and she would drop back. I may be mistaken. That is only a theory.

MR. F. P. PALEN: This trial between the *Tashmoo* and the *Erie* has developed a little point which is, I think, of very decided interest to all who are engaged in running trials, and that is this matter of depth of water and the influence on speed. I wish we had a little more information on this point. I was particularly impressed by the remark of one of the gentlemen a moment ago, who said that he was surprised that six fathoms of water under the ship would have an influence. I remember one time of running on a ship where we were taking very accurate data, from New York to Savannah, and the depth of water ran all the way from twelve to sixty fathoms, and in indicating the engine and keeping track of the revolutions and also

the speed of the ship, we could also plot the depth of the water. That was a ship of about 6,000 tons displacement.

A MEMBER: Was she a screw?

MR. PALEN: Yes.

A MEMBER: What was the speed, please?

MR. PALEN: About seventeen knots.

MR. F. L. DUBOSQUE: There is very interesting data here in reference to the Howden system, giving dimensions of the blower and so forth, and as this seems to have been a very good performance for the Howden system, I would suggest that the speed of the blower be given in the paper.

THE CHAIRMAN: Any other remarks? If not, with your permission, I will touch on some of the points that have been raised by the various speakers. As to the matter of these illustrations, they were put in the paper at my suggestion simply to show the character of the boat. I think the criticism of Mr. Andrew Fletcher, Jr., is a good one. You are not to understand that we were in that condition on the day of the race. The *City of Erie* was stripped to the extent of taking the life-boats down from the upper deck and placing them on the main deck. The flag-poles were taken down, and that is the only stripping that was done. That, however, was, I think, quite an important item, and that was done at the instance of the Captain of the boat. The *Tashmoo* did not have her life-boats taken down nor her flag-poles. That is the only lack of preparation noted. She came there prepared for the race, and, as I have been creditably informed, the engine was specially prepared for the race to the extent of trying to make her condensing apparatus more efficient in order to take care of the increased pressure on the engine. In other words, it was very much easier for those on the *City of Erie* to get a very great increase over the normal horse power than it was on the *Tashmoo*. I perhaps would not have mentioned this excepting that Mr. Babcock asked if there was any special work done on the condenser of the *City of Erie*. There certainly was not. She took care of the steam perfectly well, and, as you see by the vacuum mentioned, sufficiently well for the purpose of the day in spite of the great increase in the horse power. On the other boat, however, I understand they covered the condenser with some form of coating, and then played water upon it from the steam pump in order to increase its efficiency. Of course that made a mussy engine room and made considerable vapor in addition to the leaking of the snifting valves, and that was why they did not take cards. On the *City of Erie* everything was in such perfect order that anybody could go to any part of her engine or boiler room at any period of the trial without trouble. The engineer, and most of the time myself, stood simply in front of the engine observing. I kept a careful log of the performance of the engine every five minutes, and we had positively nothing to do. There was no trouble in taking the cards any more than there would be on her regular business. But that is all due, of course, to the favorable style of engine for that sort of work.

As to the dropping back that Mr. William H. Fletcher refers to, I think that is due to variations in the course of the boats, rather than to any variation in

speed. I am informed, and I believe that the information is correct, that the pass-over valves on the *Tashmoo* were not opened until the last half hour. Mention of that is made in the paper. But two boats traveling side by side, one varies from side to side and the other varies, and that would make an apparent going forward and dropping back.

MR. W. H. FLETCHER: It has been suggested to me that the condensers on both boats were jet condensers.

THE CHAIRMAN: As to the speed of the blowers on the *City of Erie*, I think that is impossible to tell. That was one of the minor points we did not pay much attention to. We did all we could. That is all there is about that. The effort was to get there, and we did. No notice was taken of small matters like blowers. Most of the blowing was done afterwards. Speaking of that reminds me of an interesting incident that occurred as we were going over the Cuyahoga river that morning. Cleveland being the headquarters of the *City of Erie*, she was saluted in great style by every tug-boat and every boat in the harbor all the way out, and there was a great fuss made by every boat there. One of the firemen who stood near me said: "That is all very well, but I hope they will be doing the same when we come back." It is needless to say they were. As to the dip of the wheel on the *City of Erie*, Mr. Kirby and I talked that matter over last winter. We knew that it would be a very close race. He is the father of both boats, and was sought by the managers of each of the boats to go on the boat on the day of the trip. But he wisely concluded that his best place would be on shore, because he was responsible for both boats, and he thought he would show no preference. But we came to the conclusion that about five and a half feet dip would be about the proper mean for the *City of Erie*. That is to say, we were working her so we would get about five and a half feet dip. I went up to Cleveland a day or two before the race, and made two trips with her between Cleveland and Buffalo just to look her over, and I found there was a sentiment there that we ought to run the boat as light as possible. So that on the morning of the race the Captain said to me: "How will you have this boat loaded? I will leave it to you." I said I would like to have five and a half feet dip of the wheels. Well, he thought that would make a great deal of load; "but," he said, "I will put it wherever you say." I had learned in the meantime that every man on board the *City of Erie* had bet on this race. I made up my mind if I said five and a half feet dip and they put that load on and lost the race, I should have to walk home. So I compromised on the matter, but we put on a sufficient load.

The author of the next paper being absent a brief abstract was given by the secretary.

THE EFFECT OF VARIATION OF DIMENSIONS UPON THE STRESSES IN A SHIP'S STRUCTURE.

BY PROFESSOR HERBERT C. SADLER, MEMBER.

Abstract.

In this paper the author discusses the variation of both bending and shearing stress due to change in the dimensions of the ship. Considering the principal di-

mensions length, beam and depth, any one may vary, any two may vary, or all three may vary. There will be, therefore, seven cases and each of these will contain two subdivisions according as the draft is kept constant or varies proportionately with the depth. The effect of variation in the dimensions in these various ways is shown in tabular form, it being further assumed that when a horizontal or vertical measurement varies the thickness of material in that direction varies in the same ratio.

To insure a constant stress, provided the variation in dimensions is not too great, the variation in thickness of material is shown in a similar tabular form for the various possible variations in proportions as referred to above.

These various deductions are based on the assumption that as the size of vessel increases, the dimensions of the wave upon which she is supposed to be poised, increase in the same ratio. It is pointed out, however, that with excessive size of ship it is certain that such waves will not be encountered, and hence as size is increased the conditions of support will become gradually less severe, and hence the stress upon the structure will be relatively reduced. The relation of the ship to the wave is considered in some detail, especially for the largest sizes at present found in commercial practice, and the conditions necessary for a constant stress are considered in reference to the increase of size, the relative decrease of wave height and the prevailing modifications in structural features.

In an appendix are given some notes regarding the most convenient manner of carrying out the computations required in investigations of this character. The paper is also accompanied by diagrams illustrating various features of the discussion.

DISCUSSION.

THE CHAIRMAN: Gentlemen, the paper is before you for discussion. We would like to hear from any member. If there is no one that cares to discuss this paper at the present time, the usual course is open of sending to the secretary any discussion that members may desire to submit on this subject. Meantime I will take it for granted that a vote of thanks has been offered, and ask you to consent to the same for the writer of this paper.

POWER CONSUMED IN PROPELLING THE WHITEHEAD TORPEDO AT VARIOUS SPEEDS.

BY FRANK M. LEAVITT, ESQ., MEMBER.

Abstract.

This paper gives the results of a series of tests of Whitehead torpedoes constructed for the Navy Department by the E. W. Bliss Co. The tests consist of two series: (1) A series of shop tests of the motive power as measured by an absorption dynamometer, and (2) Tests of the torpedo over a measured range under service conditions. The first series serves to give the power developed per pound of compressed air consumed, while the second series gives the speed developed and air consumed. The combination of these gives the power required in relation to the speed developed, the final object of the tests. For the shop

tests a special form of absorption dynamometer was employed, consisting of discs of metal running in a casing partially filled with water. The frictional action of the discs on the water tends to set up a rotary motion which will give rise to a tangential pull on the casing, thus tending to set up rotation in the latter. This is resisted by a spring balance, and thus the torque is measured and power determined.

The results of a very large number of tests of torpedoes carried out in this general manner are given in both tabular and graphical form. The paper is illustrated by outline drawings and photographs of the torpedoes, and by photographs of the apparatus employed. A general summary of the results shows that at speeds ranging from 25 to 33 knots, the shaft horse power required for the usual size of torpedoes ranges from 28 to about 77.

DISCUSSION.

SECRETARY CAPPS: I suggest, Mr. Chairman, that we follow the usual procedure in such matters. There are a great many who undoubtedly would like to add to this paper in discussion, who are unable to be present, and I suggest that the usual privilege be extended of letting them send their communications to the secretary to be embodied in the proceedings. Of course a paper of this kind presents exceedingly valuable data that cannot be well discussed off-hand, and we were very much delayed in the printing, so that it was not possible to circulate the papers much in advance of the meeting. But I am sure that the Society is very much indebted to Mr. Leavitt for getting such data and for presenting it in such an interesting form.

THE CHAIRMAN: You will see that the next papers on the program are the prize competition papers on the Balancing of Marine Engines. I have just been handed this memorandum: "The Chairman has the pleasure of announcing that the first prize paper bearing the motto, *"Labor omnia vincit,"* was presented by Naval Constructor D. W. Taylor, United States Navy. (Applause). And the paper bearing the title "Let Truth be our Guide," to which was awarded the second prize, was presented by Rear Admiral George W. Melville, United States Navy." (Applause). It is needless to say I hope that the committee did not know that we had bagged such big game. The Society is to be congratulated on having such contributors to its proceedings. The first prize paper, by Constructor Taylor, will now be read by Mr. Taylor.

THE THEORETICAL AND PRACTICAL METHODS OF BALANCING MARINE ENGINES.

BY NAVAL CONSTRUCTOR D. W. TAYLOR, U. S. N., MEMBER.

Abstract.

In this paper the influences on ship vibration of certain features other than the engine are first noted. These relate chiefly to the propeller, which may be either out of balance itself or with different pitches for the various blades, or so situated relative to the water in which it works that the forces developed during a revolution vary over a considerable range. The experiments of Yarrow some years ago are quoted in support of these points. The elementary features of the vibrations of ships are then briefly discussed, together

with reference to the present status of engine balancing. The author then proceeds with the genesis of unbalanced forces in detail, first in a single cylinder engine, and then in those with multiple cylinders and cranks. These are developed analytically, including, however, no forces beyond those of second period.

The application of graphic methods, especially by the use of force of moment polygons is then considered. The general conditions for the balance of an engine are then discussed, and it is shown that reciprocating weights cannot be balanced by rotating weights. By way of illustrations, diagrams of the primary and secondary force and moment polygons for four United States naval vessels are given. The author then takes up in order the balancing of engines with one, two, three, four and five cranks. The conditions necessary for a balance are discussed together with the possibilities of the various types and arrangements.

MacAlpine's two cylinder, single crank balance is here referred to, and its possibilities are discussed. The influence due to valve gear and other secondary weights is then briefly discussed, reference being made to the appendix for the details of the mathematical discussion.

The appendix contains the details of the mathematical discussion of the various cases treated, thus conveniently separating the mathematical details from the general discussion of the problem. The paper is accompanied by a large number of plates with diagrams and drawings illustrating the text and intended to aid in the practical application of the principle involved.

SECOND TECHNICAL SESSION.

In the absence of the author the first paper of the session was presented by Mr. W. M. McFarland.

THE THEORETICAL AND PRACTICAL METHODS OF BALANCING MARINE ENGINES.

BY REAR ADMIRAL GEORGE W. MELVILLE, U. S. N., MEMBER.

Abstract.

This paper opens with a general discussion of the problem involved in the balancing of a marine engine, and with an account of the various systems which have been proposed for the accomplishment of this purpose. The systems especially referred to are the Yarrow-Schlick-Tweedy and the MacAlpine, which the author advances as the best solution of the problem. The mathematical discussion opens with the consideration of the problem of balancing a simple revolving piece, first singly and then in multiple as a number of cranks distributed at various angles. This discussion leads to an exposition of the possibilities of the use of revolving weights and of unequal crank angles for the complete balancing of an engine, and from the expression for the forces due to the reciprocating parts and connecting rod it appears that by no such combination possible can such forces be balanced.

Attention is also called to the short period forces arising from the influence of terms arising in the complete expression for these forces, and the importance of providing for their counterbalance is insisted on. A graphical method is then given for readily judging of the importance of the second period forces in any

given case. The importance of balancing couples as well as forces is then pointed out and illustrated by reference to various actual cases.

The paper then proceeds to a detailed discussion of the MacAlpine balanced engine as a solution of the general problem under consideration. This engine consists essentially of a pair of cylinders, one mounted directly over the crank and connected to it in the usual manner, and the second athwartships outboard, and connected to the first by a beam. Such an arrangement with suitable weights and proportions will give a complete balance of free force and couple, but there will be left a torsional couple. This, however, is shown to be of small size, and it is claimed that it may be safely neglected. Two pairs of cylinders thus arranged would therefore provide for the balance of the usual quadruple engine, or four cylinder triple. The design and balancing of an engine of this type are then taken up and discussed in detail with the aid of a numerical example. Various types of engine, both for warship practice and for mercantile practice, with attached pumps and balanced on this system are then discussed and their applicability to all usual cases of marine propulsion is pointed out. The paper is accompanied by several plates of diagrams and drawings, the latter showing various forms of design of engines balanced on the MacAlpine system.

DISCUSSION ON THE PRECEDING TWO PAPERS.

MR. WALTER M. MCFARLAND: I think the college professors are the only people competent, besides the authors of the papers, to discuss them. I frankly admit that I am not. I said that from the beginning. I believe that these two papers are of extremely great value, and I believe it will very well repay every member of the Society to study them with the utmost care, because I believe there is an enormous amount of most valuable information in them. Of course, I am not so directly connected with the work of this Society as I was once, and my time is taken up in studying other things, and I expect that a good many others find that in the practical work of the profession it is a good deal easier to look up a formula in a book, or, when such authorities as Mr. Taylor recommend a certain thing, we feel like taking what is recommended on trust, and going ahead. We don't feel like going back to the beginning.

MR. W. D. FORBES thought that very much depended on the degree of excellence with which the mechanical work was carried out—that the results of elaborate mathematical calculations might go for naught unless the work should be carried out in such a manner as to make possible the conditions implied in the theoretical investigation.

PROFESSOR CECIL H. PEABODY: It is not necessary for me to add to the praise which has already been given to these articles. The feature which most attracted my admiration in the prize article is the very thorough and complete manner in which the author has worked out the problem so that we may have certain definite results. There is one item I would like to call attention to, and that is that the author has used an approximate method; doubtless a good enough approximation may very commonly be carried to a degree, and can be shown to be carried to a degree where

further trouble is not worth while. I believe, however, that both approximate methods and graphical methods for these investigations are entirely unnecessary, provided you can get somebody else to do some work for you before you start. That, however, I think can be done, and is done. No one is at all concerned as to how much work it costs some one to make a table of logarithms, provided he can get it and use it. If simple tables are made in a proper form, the acceleration can be obtained by a simple process of multiplying a constant by the number of revolutions squared, and by the crank; and the other accelerations, as for the connecting rod, can be treated by a little more difficult method. I call your attention to the discussion given by Professor Lanza upon a paper by Professor George I. Alden, in the Seventh Volume of the Proceedings of the American Society of Mechanical Engineers, in 1886, page 181, in which discussion Professor Lanza gives some tables of this sort, tables of the sort we are accustomed to use. This, of course, is only a discussion of method, and I believe that while a graphical method always seems very attractive to a person who is not accustomed to using mathematics all the time, that if we can get this work properly systematized, it can be made even easier than by the use of the graphical method.

PROFESSOR WILLIAM F. DURAND: I think all will admit that no one, whether he be a professor or not, is qualified to intelligently discuss these papers without time for careful consideration. The papers are so exhaustive and cover such wide ground that a cursory glance through them or a first hearing is quite inadequate to give that hold on them which is needed in order to make possible any really valuable discussion. There has been so much said already in praise of the papers that perhaps nothing more is needed on that point, but I do feel, in common with the others who have spoken, that we as a Society are to be congratulated on having presented at our annual meeting these two papers. I think it is a point on which we may properly take pride. I think that the donor of the prize may also take credit to himself for having been the occasion of the production of these two papers. One little point that strikes me as I am speaking of the exhaustive character of these papers is this: All who have followed the literature on this subject know that in the last ten or twelve years there has been a tremendous output, and if a person should start in today simply wishing to look it up, he would find it a very serious undertaking to go through the mass of matter which has been written and printed bearing on this particular subject. Now, while I would not say, and I am sure that the authors of the papers would not maintain, that in these two papers the last word has been said on balancing, or that everything has been said which may be said, yet I do think that these two papers together give us a wider sweep and range over the subject than we would readily obtain in any other way. If we take these two papers and go through them and make them our own, I feel that we shall have a very thorough and satisfactory understanding of the problem, of its character, of the means available for its solution and of the various ways in which solutions may be attempted and reached. As

I said a moment ago, we are not to assume, perhaps, that the last word has been said on this subject; but I think that we may say that we have the solution now well in hand. We know just what it requires. We know the various ways in which it may be sought and obtained, and it seems to me that the work immediately ahead of the engineer who is seeking to advance this part of the subject will not be so much in the way of seeking new solutions or of further mathematical investigation, but rather work which shall aim to adopt methods to readily use in the drawing rooms. I have had on more than one occasion draftsmen and others, who have been some little time away from their mathematics, say to me: "This is all very well; I should like to follow out this or that method of investigation; I would like to apply some such method, but it is too much work. These things are not familiar to me. I am rusty on these subjects. Is there not some way in which we can simplify the thing?" These remarks, of course, are along the line followed by the last speaker, and it seems to me that so far as balancing is concerned, the work of the engineer in the future will be largely along these lines; the adaptation of these elegant mathematical methods, which have been so exhaustively discussed and presented here, in such a way that the practical man shall have with the minimum trouble, a solution of the problems which arise in his daily experience.

MR. CHARLES P. WETHERBEE: The last speaker leaves very little for me to say. I agree most thoroughly with everything he has said. I wish to congratulate Mr. Taylor and Admiral Melville on the papers. I was going to say if Professor Durand had not spoken otherwise, that the literature is closed on the subject. The method that Mr. Taylor has shown us is really a short cut to the solution of the problem that has, I think, bothered all engineers in designing fast-running engines. The principal difficulty has been in the use of the analytic methods. Take an engine in a certain condition the results can be worked out, but when it comes to saying what to do to improve the conditions, the previous solutions of the problem have been very unsatisfactory. When it comes to the application of these papers, there is always a practical limit as to how close to the ideal you can go. I have found that it is not necessary to get absolute balance on an engine, even in the very fastest modern engines in very light vessels, and it is worth a good deal to know just how far you can go. The three-cylinder engine is not balanced by a good deal, but it can be made, by following the methods indicated by Mr. Taylor, sufficiently well balanced for all practical purposes, and it has great advantages in the way of simplicity, et cetera. Of course, every effort has to be made to get the axes of the cylinder as close together as possible, to have the reciprocating parts of the same weight, as nearly as possible, in all cylinders. Now, as to the single engine Mr. Taylor spoke of, he passed over that very quickly, but the single engine still seems to have a reason for existence in blowers. The single engine makes a good engine still to drive a blower, and for that reason the balance of that engine should be very carefully attended to. It is a question whether we should do as Mr. Taylor indicates this

morning, simply balance all the rotating weights by counter weights, which, of course, leaves a large unbalanced force still in the direction of the axis of the engine; or whether we should overbalance the rotating weight. I think perhaps we should overbalance the rotating weights a little. Now, as to the position of the revolving weights in an engine of more than one cylinder, Mr. Taylor points out that the proper way is to put the weights as far apart as possible, one on each end of the engine, and thus form a couple which is in the proper plane. This solves the problem with the minimum weight; but in many cases of fast-running engines the cylinders can be put closer together than the crankshaft will allow you to have them if you have proper bearing surfaces with this method. The addition of counter weights at each cylinder reduces the pressure on these bearings and enables you to use smaller or shorter bearings, and thus contract your engine in a fore and aft direction.

PROFESSOR DAVID F. JACOBUS: I admire very much the quality of these two papers, and I feel that too much praise cannot be given to the authors. Some time ago I myself worked on the problem of determining the force produced from reciprocating action, et cetera, and the size of the counter weights, and I have off and on, I might say, worked a long time on the problem, and knowing what I do of the difficulty, I can appreciate how much praise is due to the authors.

In regard to the forces on the connecting rods, in one of the papers there is a solution which is certainly a very neat one. That was a special hobby of mine at one time, and I got up exact formulas for a connecting rod, in a general sense of the term. I went a little further than a connecting rod symmetrical about the center. I supposed the weight distributed in any manner, and also took the action of the Westinghouse engine, where the center line does not pass through the center of the crank. I also worked on lines which have here been suggested, on tables which could be used for getting various constants, and in that way get a value for both the inertia forces acting at the wrist pin due to the horizontal motion, and the forces due to the lateral motion of the connecting rod; and if such a thing is not out of order, I would like to have the privilege of putting in a brief abstract of that method just to carry out the investigation one step further, in one little part, and then probably add one page of these tables that could be used for getting at these forces.

NAVAL CONSTRUCTOR JOSEPH H. LINNARD: A point which seems to me not to have been touched upon in comparing these papers is one which I understand is really the fundamental difference between them. I have not had time to read these papers carefully. If I understand it, Mr. Taylor, in using his graphical methods and in considering the whole problem, regards as unimportant the higher period vibrations produced by the obliquity of the connecting rod, et cetera, which are multiples and higher multiples of the period of the revolution of the units. Admiral Melville, in his paper, lays great stress on those high period vibrational forces and moments, and says, with justice in one sense, that if they are of equal absolute value, occur-

ring with a multiple number of frequencies, their total amount is much greater. But I think those of us who have experienced vibrations in a ship find that the vibrational period of a ship rarely goes up to those higher multiples, showing that the ship cannot respond, as it seems to me, to the higher vibrational periods upon which so much stress is laid in Admiral Melville's paper. I do not pretend to be an expert in those matters. Like some of the others, I am very rusty on my X's. But it is a point that does not seem to have been discussed, and which I would like to see more elaborately elucidated, if possible, why those differences exist in opinion, and if there are means of reconciling them.

MR. DUBOSQUE: I have tried to follow this paper through, and what I have to say may be because I have not been able to. But after reading the article by Mr. Yarrow on balancing marine engines by the use of bob weights, I was very much impressed with the possibility of correcting a very bad design of engine that we happened to have in a tug boat, which the pilot claimed almost knocked the pilot house from over his head, the vibration of the boat was so excessive. We fitted it up as nearly as we could follow the idea of Mr. Yarrow, and counterbalanced the moving parts, and I looked forward with a great deal of pleasure to the trial trip of this boat. After we had gone out and come back the pilot said: "It is worse than before." A little further investigation showed me that I had not got the fore and aft position of the center of gravity coincident. Now, in this treatise I do not find, if I followed the paper rightly, that very much attention has been given to the fore and aft position of the center of gravity. I noticed Mr. Taylor, in his four cylinder engine, places his low pressure engine on the end and reduces the weight of the moving parts as much as possible, in order, I presume, not to have the axis of gravity out of plane. But it occurred to me that that point was not well enough brought out. Possibly it will be referred to in the response to the discussion.

MR. WILLIAM H. FLETCHER: The next thing to being able to write a prescription is to testify to its results. It is a little peculiar to us that those of us who are brought up in the home of the beam engine and have had experience with both of the methods suggested by these papers—I built a twin-screw engine designed by Mr. MacAlpine, a three-cylinder engine, and installed it in the steam yacht, *Sovereign*, now the *Scorpion*, United States Navy. Had we not built the *Corsair*, following her, we should have been prepared to say there was nothing equal to that engine. We have since built the *Corsair*, four-cylinder triple-expansion engine, with the cylinders distributed as recommended by Mr. Taylor; that is, the high and intermediate, in the center, two lows at the end and the air pumps connected to the low pressure cylinders, and I think it is only right to say that as far as we are able to judge, it is about as near perfection as a man can hope to attain in anything connected with a steam engine. I do not mean to say that the thing cannot go further, but I only wish to testify to the results of the application of the theory as laid down.

THE CHAIRMAN: In the engine that you refer to, Mr. Fletcher, the cranks are balanced by the Yarrow-Schlick-Tweedy?

MR. FLETCHER: They are balanced by the Yarrow-Schlick-Tweedy. We sent them the drawings and the weights of all the moving parts, and they gave us the position of the cranks. We did not pretend to work it out. But I will say this, that we tried to adhere and did adhere in every particular to the weights we sent them, and so far as the vibration of the boat was concerned, it would seem as though little could be desired. The wheels, I might also say, were very carefully balanced.

MR. WETHERBEE: This matter of the balancing of the wheels I forgot to mention before. I find, as stated by Mr. Taylor, it is very possible to have a propeller wheel that is perfectly balanced dynamically, and still be the cause of great vibration, owing to the fact that the pitch is not the same on all the planes, and in a propeller which is cast in one piece this very frequently occurs from the fact that the propeller is bored to an axis which is not the designed axis of the propeller. The propeller comes from the foundry and is put on the boring mill. Ordinarily the machinist puts the different blades at the same height above the mill on a block, and if there is any error at all in the casting, this makes the propeller so that it is bored in an axis not the designed axis, and for that reason one of the blades at least will be of different pitch; they may all three be of different pitch, or we may have two alike and one of different pitch. I have found that this is a matter requiring a great deal of attention,—the placing of the propeller on the boring mill. With a built-up propeller the same thing applies. When the propeller is prepared to be bolted up, the angle of the blades to be placed there should also be determined. The way I do is to put the propeller in the boring mill and take a bevel and clamp up to the tool-post, and set all the blades so that they have the same bevel.

THE CHAIRMAN: Is there any further discussion? If not, I will ask Naval Constructor Taylor to complete this discussion on his part.

NAVAL CONSTRUCTOR TAYLOR: Mr. Chairman, I have very little to say in reply to the discussion. I wish to thank all the gentlemen who spoke so kindly of my paper—much more so than it deserved, also to extend my commiseration to the committee. I think that I should say, with reference to some statements made by Mr. McFarland, referring to my paper of 1891, that that paper was by no means so complete as the present, for, although the methods used were the same as in this paper, I carried them only as far as with reference to the primary forces; I neglected the effect of the obliquity of the connecting rods. That paper was also on the propeller. So far as I know, the first person who made the extension applying these graphic methods was Herr Knoeller, Professor in the Technical High School of Vienna. He published, in 1897, in the Transactions of the Austrian Society of Engineers and Architects, a paper on the subject, in which he extended those methods to cover both the connecting rod and the effect of obliquity.

With reference to Professor Peabody's statements, I think you will find that table 1 on page 24 gives ex-

act values of accelerations of the reciprocating weights for various stated connecting rod ratios. Exact values are compared with the values from the approximate formula, and this was made for the three different connecting rod ratios, 4, 7 and 10, in order to show how rapidly the formula approached the exact value as you increase the length of your connecting rod. The maximum error for a connecting rod ratio of 4 is about 6-10 of 1 per cent of the maximum acceleration, and for a connecting rod ratio of 10, the maximum is about .046 of 1 per cent of the maximum acceleration, showing how rapidly these secondary forces fall off.

With reference to the point raised by Mr. Linnard, of the higher period forces, the fact that the approximate formula agrees so closely with the exact values shows that these higher period forces are small. I think that it is a question about which there seems to be some difference of opinion—not on my part, because I did not express any opinion—the question as to the effect of these higher period forces is one that can only be settled by practical experience, and about that we have very little information at present. I do not believe myself that a structure such as a ship, as Mr. Linnard said, can respond to forces having a frequency of two or three thousand a minute, which you get up to with the fourth and sixth period forces of an engine making several hundred revolutions a minute. That is a question which certainly needs further investigation, but I do not think it can be said to have been established one way or the other. Another reason why I neglected these higher period forces was that my object was to discuss what could be done with various numbers of cranks. As I have shown, in the second part of my paper, that we cannot get rid of the higher period forces with less than six or eight cylinders at least, it seemed unnecessary to go into that. They are very small anyhow. I think if Mr. DuBosque will read the paper more carefully he will find that the question he raised with reference to the fore and aft position of the center of gravity, which I take to mean the question of rocking couple, is discussed in the paper.

With reference to the Yarrow-Schlick-Tweedy four-crank balance, I do not think they restrict themselves to four cranks. As pointed out in my paper, it is not a complete balance. You will find there is a secondary couple left, and to determine the amount of that couple in any case you will find Diagram G gives the residual secondary moments. That, taken in connection with the preceding diagram, is for an engine in which the primary forces are balanced and the secondary forces also are balanced. As to the necessity of going to five cranks where you have no forces of a lower period than the fourth power, that is a matter that is readily settled by practical experience. Mr. Wetherbee thinks it is not entirely necessary to get rid of primary forces, and Mr. Fletcher seems to think that the balance applied on the *Corsair*, where there were undoubtedly secondary moments (because the Yarrow-Schlick-Tweedy system cannot get rid of secondary moments), was all that can be desired from the practical point of view. If it is absolutely necessary to get rid of secondary moments it will be necessary to use some such system as that proposed by Mr.

MacAlpine, or else to go to the five cranks. I do not think it can be done otherwise.

SESSION OF FRIDAY FORENOON.

The meeting was called to order at 10.35 a. m., on Friday, November 15th, Colonel Edwin A. Stevens in the chair.

In the absence of the author the first paper of the program was read by Naval Constructor Taylor, U. S. N.

A BRIEF COMPARISON OF BATTLESHIP DESIGNS.

BY NAVAL CONSTRUCTOR H. G. GILLMOR, U. S. N., MEMBER.

Abstract.

In this paper a comparison is undertaken between typical modern battleship designs of the leading naval powers, including England, Germany, Russia, Italy, the United States and Japan. France could not be included on account of the meagerness of the data available. The leading characteristics of these vessels are given in outline diagrams and in tabular form. An effort is then made to give a numerical value to the different designs in order to compare them with one another. To this end a type design is taken consisting of the vessel of largest size and with the minimum values for the various features, armament, protection, speed and coal supply. It was then assumed that for the purposes of the comparison the weights involved could be used as the basis. For the minimum range of such features the weight allowed was 4,300. The various additional features above such a minimum are then estimated and added, giving the final figure of value. On this basis the ships were found to compare with values as follows: *Virginia*, United States, 7,050; *Mikasa*, Japan, 6,730; *Vittoria Emanuele*, Italy, 6,560; *Duncan*, Great Britain, 6,300; *Borodino*, Russia, 5,790; *Wittelsbach*, Germany, 5,260. These various values are then further divided, each by the displacement of the ship and the result is taken as a factor called the "efficiency of design." These factors are as follows: *Vittorio Emanuele*, .520; *Virginia*, .472; *Duncan*, .450; *Wittelsbach*, .446; *Mikasa*, .443; *Borodino*, .427. It is pointed out that the data in the case of the *Vittorio Emanuele* is subject to some uncertainty, especially as regards the displacement given. Finally, to quote the closing words of the paper, "The purpose has been to roughly estimate and express in concrete terms the relative naval values of the several vessels whose designs were considered, in order that the results of this comparison might be presented in a form more tangible than that of a general discussion of the several features of the design."

DISCUSSION.

REAR ADMIRAL FRANCIS T. BOWLES: Mr. Chairman and gentlemen: I am sorry that the chairman has deprived me of the privilege I hoped to have of being the last to speak, a situation that has some advantages. This paper presents the subject of battleship design from a remarkably simple and interesting point of view; it is purely the naval architect's point of view. It does not involve any assignment of relative value to the different points in a design, and it is free from all those confusing things called "muzzle energy" "rates

of fire," and different things which puzzle people so much who are obliged to consider these designs. It is simply a question of balancing up tons in which the tons of the different countries are given the same weight. I notice that Russian tons and American tons and English tons are all considered of equal value and efficiency in making up the results in the design. There is one peculiarity of all these methods of evaluating paper designs—I notice that wherever they originate they bring out the local battleship to be the best—a very proper thing, of course. I think the most serious error in this comparison lies in the neglect of the difference in the protective decks, and the author has probably found it impossible to get sufficient data on that point to introduce it into his comparison, and that leads me to point out one of the differences between our own battleships and some of the foreign designs. The *Duncan* class, representing all the English battleships, uses much more weight in the protective deck than any of our vessels, because they carry really a double protective deck; one which covers the top of the main armor belt and involves the use of a large amount of weight which does not appear in this comparison. That would probably affect the relative value of these designs very considerably. That point is the only one which I wish to bring out. But there is a tendency shown by these designs which we may as well face now. When the relative value is given to the different elements in these designs it will be found that some of the foreign types possess considerable advantage in the individual protection of the battery given by armor, and that is apparently an increasing necessity due to the probable use of high explosives, and the great and increasing power of the modern gun. The result will be inevitable that the battleships will increase in size, and it is to be hoped that while they increase in size they will not increase in complexity. Therefore, we must look for a very considerable increase in size in the battleships to be built for the United States Navy, and I would like to assure you that whether they are built from the designs of the majority or the minority, we hope that the supremacy of the individual battleships of the United States will be unquestioned.

CAPTAIN VON WEBER: Mr. Chairman, since I have been for nearly five years in the United States I think that I know probably more about the United States battleships than the recent German designs. It is really difficult to keep up with both, and regarding comparison between your battleships and ours, while being highly interesting, I need data of my own ships to go into the subject thoroughly. What always interested me in the battleships of your design is especially the enormous amount of coal which they carry, and while the German battleships are probably behind in this particular, with all the others, this appears, of course, a rather startling fact, which, however, I think is based on reasons which have been very carefully brought out; that is to say, the amount of coal which the battleship needs to carry before it gets to another station where it can fill up with coal either by coaling ships or by coaling stations. When Admiral Bowles spoke of the constantly increasing size of battleships I am rather surprised to find that to my knowledge

you formerly tried to keep down the size of battleships so as to be able at all times to enter your own harbors. I recall the fact, because I think it is in the last annual report of the Chief of the Bureau of Steam Engineering, published by the papers, which said that on the Pacific Coast there is at present only one dock which your battleships can enter, that is at Puget Sound, while the new dock built at Mare Island Navy Yard, I think, at present, cannot be approached by battleships of any size, because there has to be extensive dredging. I should be very glad to know how far the increasing size of battleships needs deeper draft. Probably we could learn something about this fact.

CAPTAIN TCHERNEGOWSKI pointed out that all these methods of evaluating ships may be good in one respect and bad in another. He considered that not sufficient weight was given to the efficiency of the personnel of the ship, and pointed out that everybody in relation to the ship must be taken into account, and that the technical condition of the country was also a point of great importance.

LIEUTENANT CHANDLER: There is only one thing that struck me in this comparison of weights to which Mr. Bowles referred. Of course this method of comparison seems valuable and undoubtedly is. I do not know of any more important one, but at the same time in comparing efficiencies of different ships of different types I do not see how any satisfactory conclusion can be reached that does not include what Admiral Bowles called the vexing questions of "arcs of fire," and "muzzle energy," and one thing and another of that sort, and I think to take an extreme case, the necessity for considering that point has been shown in several instances in different countries. I think notably, if I remember correctly, in the little trouble that the French had with the Chinese, where the Chinese had a number of gunboats, which had one gun pointing forward with very little train, and when they did not get springs on their cables and an ebb tide set in, those guns were not very valuable against a fleet coming up the river. So that I think for a really efficient comparison of ships those troublesome things have got to come in, and after more or less looking around in a casual sort of a way I do not quite see how it is going to be done. I know that there was a very extensive paper came out some time ago, I think, by a constructor in the German Navy, which assigned weights, etc. I started in on that very faithfully, and I got about half through when I concluded that the method was too complicated, and laid it by.

LIEUTENANT COMMANDER WHITE: I am very much of opinion that in our comparison we are comparing ships from what they apparently are. You cannot tell from looking at the outside of the sketch of a ship what it is inside. That has a very marked effect upon its value as a battleship. If the *Virginia* has an open gun deck with six guns all in one casemate, her effectiveness as a battleship as compared with a battery of six-inch guns that are in closed casemates, as the *Duncan*, is very marked. Whereas it would take one shot or two shots to put out the entire personnel of that battery, of the *Virginia* it would take at least six to put out the personnel of the *Duncan*. You will have considerable space that you can shoot at without hit-

ting anybody. But it is not all questions of that kind alone. There are other elements that come into the design which are not shown in this, and one is the question of ammunition supply. It is probable that in the closed casemates each casemate will have its own source of supply, and each individual gun has its own source of supply properly protected. Our later battleships are very defective in this respect. The question also comes up of the protection which the armor of the ship apparently gives to the gun. If you look at these battleships you will find that all the six-inch guns apparently have the same amount of protection. As a matter of fact, if the *Virginia* is to be designed like some of our recent ships, with the same port openings, the gun and gun crew will be exposed very largely to attack, not only from the six-inch gun, but also from the secondary battery, which will not only knock out the gun crews, but will also injure the guns. This is markedly true in the case of the turret guns. The turret openings are so large that even in the eight-inch turret there is room for four or five six-inch shells to enter at any one time. This criticism is not without some reason. It is possible to make a port opening so that there will be no exposure whatever from the outside, or very slight, nothing except for the sighting of the gun, and that is absolutely necessary if we are going to keep our guns from injury from the secondary battery fire. The thirteen-inch guns or twelve-inch guns, of course, are so open that in the ordinary ranges of from fifteen hundred to two thousand yards the exposure is so great that the whole turret could be so damaged by a single shot that the main battery on the ship would be entirely useless. The question of the superimposed turret, of course, comes up periodically, but there is one point which has not been given sufficient weight. The shots which will be undoubtedly made at the main battery if they go a little over the turret will land in the eight-inch turret, and the injury to the eight-inch turret, unless the floor is very heavily armored, is going to injure the thirteen-inch turret as well. The eight-inch turret would catch about twenty-five per cent of the shots that would clear the lower turret on account of the height of the target. Then there is another question. The double decked turret is a very marked feature of our ships. It is one that it is not necessary to have a telescope to discern, and that would make it the principal target for the main battery of another ship. If you can make your target as unobtrusive as possible it will make it just so much more difficult to fire at. I noticed, particularly in the case of some English battleships which I saw in the East, what is called the shield—it is not called a turret—the gun shield, was so inconspicuous that even at a short distance it was not very noticeable. When you were within half a mile of the ship you would not notice whether the vessel you were looking at was a battleship armored with 12-inch guns, or a cruiser armed with 9.2-inch guns; there was so little difference in the general outline of the design that in the distance there would be some difficulty in picking up that important point for the marksmen. Another question is the facility with which guns may be handled and fired. In the Belle Isle experiment, I understand, when the target was examined,

they found a great many shots from the secondary battery and a great many shots from the six-inch guns, but very few from the 9.2-inch gun, which is the heaviest gun they used. We found very much the same effect from target practice at Santiago. There were very many five-inch guns and secondary battery, but very few eight-inch, and not one thirteen-inch, although there may be a record of one thirteen-inch having been fired. That is of very great importance, because on the approach of fleets toward each other they very rapidly approach at such a range that guns of the secondary battery or the second calibre, the six-inch guns, will be in a position to inflict their maximum damage. If you get as close as fifteen hundred yards—this is as close as you will arrive in a very short time—you will be in a position, if you can throw in a tremendous body of fire, to practically wipe out the heaviest guns of your opponent. Your eight-inch gun, although it throws a very much heavier shot, and each shot has the same chance of striking the enemy, yet if it has the rapidity of only two or three shots a minute, it could hardly be called a match against a gun that was firing seven and eight shots a minute. The facility for handling an eight-inch gun in the turret is very limited. The six-inch gun can be constantly trained on the target, but not so with the eight-inch, and that difficulty we shall find continually increasing as the size of the gun is increased. So I think we are not warranted in handicapping our ships with so many eight-inch guns unless the necessity is more strikingly apparent than at present.

REAR ADMIRAL BOWLES: Mr. Chairman, I would say one word in regard to the subject which was spoken of by one of the speakers, and that was with regard to the draft. The limitations of draft of vessels of the United States Navy still continue to exercise an adverse influence upon the efficiency of our design, but we must consider that other things being equal, the less the draft of the vessel the greater her usefulness. So that our limitations bear fruit in that respect, and when I say that the vessels are liable to increase in size, we have got to face the necessity for some increase in draft, on account of the great value of the defense which is given by the most efficient battleships. Therefore I have come to look at the matter somewhat from the point of view of an eminent civil engineer, who remarked to me that while the Lord made harbors that man could remake them.

LIEUTENANT WHITE: I would like to say one word in regard to the draft requirements of our vessels. The commercial requirements of our harbors are increasing right along, and the difficulties of dredging are very slight. It is only a matter of time.

MR. G. C. COOK: I see there is no reference made to torpedoes or to the efficiency of torpedoes to these designs. I believe most of the battleships are fitted with them, and I would ask if there can be any information given on that subject.

LIEUTENANT CHANDLER: As far as the putting of the torpedo on board large ships is concerned, I do not think either in this country or any other there is much doing. We are leaving them out. And while in some places they are working the submarine tube, I do not know whether it is going to hold on or not.

We have serious doubt on that point, so that I think that the torpedo can be pretty well left out in large battleship construction.

CHANGES IN TORPEDO BOAT DESIGNS.

BY CHARLES P. WETHERBEE, ESQ., MEMBER.

Abstract.

This paper opens with full data from the progressive trials of the torpedo boat *Biddle*, constructed at the Bath Iron Works, Bath, Maine. This is further supplemented by data supplied from the experimental tank in Washington, and giving as a result a full analysis of the power over the range of the trial which was from 11 to 29 knots, the curves, however, being extended to 30 knots. The various items of this analysis are further shown graphically in a series of curves. Another series of curves is added showing for boats of this type the relation between speed, power, displacement and load carried, making possible a rapid first determination of the size of boat suitable for any stated conditions. The author then proceeds to his subject matter proper, and gives a general discussion of changes, which, it is claimed, would improve the capabilities of boats of this type. The point is first made that the present type of torpedo boat is essentially a smooth water boat, and as such, many simplifications may be made and many things omitted which are thought necessary. A number of such items are enumerated and a general plea is entered for simplicity and reliability, and for a larger engineer's staff. For sea going torpedo boats and destroyers the author believes in a new type with a considerably reduced proportion of length to beam, preferably not over 8 to 1. Such boats of the larger size would have a displacement of from 400 to 600 tons, and would be able to make good speed in any but the worst of weather. He claims further that in torpedo boat sizes, this decrease in the ratio of length to beam while decreasing seriously the smooth water speed will give a better result as an all around sea boat, and in ordinary weather at sea will make better speed than the more slender but delicate harbor type of boat.

DISCUSSION.

MR. HENRY A. MAGOUN: The point that strikes me particularly is the part of the paper relating to what can be left out. I think that anybody having anything to do with these boats has run into that at one time or another, and the uppermost thing in my mind is a little matter that we ran into the other day relating to the interior communication system. I give this to illustrate what can happen. We took up with the proper parties the arrangement and requirements for the wiring conduits and junction boxes, and we quite innocently went ahead and ordered more or less of the stuff, and among it the junction boxes. Very fortunately we got one of the junction boxes before the order was filled, and on weighing it and looking into the matter we found that we had about nine hundred pounds of junction boxes on a little torpedo boat destroyer. We managed to cut that down to three hundred pounds, and I really believe that is three hundred pounds too much. I merely give that to show what you can get into very innocently indeed. In the same

connection I may say that on those boats there is about fifteen hundred feet of speaking tube, which I think weighs a pound to the foot, and we found that some of it could be very easily done away with from the fact that when a man is standing in the conning tower, there is a distance of only about ten feet between him and the place the tube was led to. Of course there are a great many other instances that could be quoted, showing almost the same thing in the other parts of the boat.

REAR ADMIRAL BOWLES: I would like to be in the beginning of the discussion, because I do not think it expedient to be drawn into the general discussion of torpedo boats at the present time. However, it is not out of place for me to express my satisfaction at the reading of this paper, and also my sincere compliments to Mr. Wetherbee upon the matter that he has laid before the Society. It is timely and necessary and proper. It is a case of very intelligent insight, based upon the most careful and intelligent application of his ideas to his own work. It shows the necessity, undoubtedly, of the continuous application of some experienced man to this subject. The criticisms that he has made are so uniformly severe upon all parts of the Navy Department that there is no hard feeling, I am sure. But the paper is not only one of criticism. He has included in this paper the actual results of his experience towards building up the subject anew, and I wish to express dissent from the basic idea of the new design, which he expresses in order that we may not be led astray in what we may do in the future. It seems to me that a vessel for the Navy which can only be used for harbor defense is absolutely useless. The torpedo boats have got to accompany the fleet, and we have no use whatever for vessels that are limited to smooth water service. These torpedo boats have got to go to sea—even those that we have. I sympathize entirely with the wish of the author for a man in Washington who has a final decision irrespective of Department, and I hope that he is growing up. That feature has expressed itself upon me in the examination of the torpedo boats and torpedo boat destroyers that are building and the effort is now being made to supply that necessity with regard to the boats that are now being completed.

MR. FORBES: Mr. Chairman and gentlemen, the paper is extremely interesting to me. I don't know why it is, but the whole Anglo-Saxon race seems to delight in killing something, and if they cannot do that, in preparing something to kill with. The torpedo boat is supposed to be a weapon of war, and a weapon of war must have the pre-requisite of absolute certainty of action. When we lose that we lose everything. The nastiest feeling that takes possession of a person is in not knowing whether or not his production is going to fail. Much worse must it be for anybody who is in charge of a mechanical contrivance where he is pretty well sure from the very start that something is going to go wrong. Torpedo boats seem to have the habit of going wrong at all sorts of times and in all sorts of ways. This must arise from one of three causes, it seems to me, or perhaps a fourth cause may be introduced. The design itself may be wrong, the workmanship and carrying out of the design may

be wrong, or the materials may be unsatisfactory; finally, if all that is satisfactory and it is not handled properly it can be of no avail. This paper evidently shows to me that we have gone too far in our designs towards lightness, that we cannot rely on what we make to carry out our work. Now it seems to me that if we are going to build torpedo boats in the future that where the responsibility lies has got to be settled. It is certainly admirable to have one man who will make a final decision. That is first rate, you get your decision, but it is not always right. I think that the Navy is doing that work most admirably, supervising everything in every way, and there is certainly in each Department some individual who has the final say, as I understand it. There is no doubt that it is the auxiliary that kills the whole business in nine cases out of ten. In the chase of the *Itata* it was the blowing engine that was always giving out. It seems to me it is not the general design so much as in carrying out the detail—some little three-eighths nut drops off and the whole thing goes, and it really seems that it lies more with people in my position to carry out thoroughly well, without haggling and without dispute, the designs that are given us by the Department. It is really in doing that that we are more likely to arrive at more satisfactory work in torpedo boats than in a general change of design. The torpedo boat referred to is from the brain, I believe, of Mr. Normand, who is undoubtedly the boldest builder of engines that we have. His work, I believe, bears a record of never having broken down. What Mr. Hyde has said bears that out. I do not think we have got that record in our own designs at all. The engines, to me, are awful looking; they look like coal hods, or anything, but they are of first class design, and they are beautiful in their results, and everything becomes beautiful when it does its work. I wish to close by saying that if the designs of the department are honestly carried out and the work thoroughly well done, and they come up to the specifications, we shall have far less trouble in carrying out the work of the torpedo boats after we get it.

LIEUTENANT ALBERT P. NIBLACK: I think that anyone that has followed the torpedo boat discussion and papers through the transactions of this Society will agree with me that if we plot the curve of their value technically, that Mr. Wetherbee's paper will be found to correspond with the high water mark at the present time. There is fortunately a disposition to follow out in practical application in design all the best ideas. These papers, of course, are more or less unsettling, because the important point from a strictly technical standpoint of the officer who has to handle these torpedo boats is that we do not really need the best if we use to the best advantage what we have. Of the thirty boats which we now have there are at least seventeen distinct designs. That is itself a misfortune and the trouble is very aptly pointed out in the fact that there is not one person who is responsible. Consequently any criticism is legitimate because there has been a lack of uniformity of idea, not only in what torpedo boats are to be used for, but in the different elements of their design. For instance, we are told now that most of the torpedo boats we have are

smooth water boats. One of the considerations which we have had to confront in designing has been the use of canals in order to have boats at one base able to go to another base through the interior line of communication, which we are fortunate to have. That, of course, accepted as a limitation, has changed somewhat the design of the smaller boat.

LIEUTENANT CHANDLER: Reading this paper, and in hearing it read I gathered a good deal, and in the main I am in agreement with what Mr. Wetherbee says. I think an especially valuable thing he has shown here is on page 8, in the paragraph about the middle of the page, where he shows with high speeds the vast increase of displacement which must be given to a vessel in order to carry a very small, useful weight inboard, I suppose we might call it, pointing out from that the necessity for keeping down weights. Now it seems to me, without endeavoring to criticize the past action of anybody, that we have sought for standardization. I believe that Mr. Niblack is very fond of it. We have it in some ways and in other ways we have to let it go. We have not always been happy. For instance, I think we have stuck to the standardization of a great many fittings, and I think it has resulted in adding unnecessary weight, and the tendency has been to lighten the boats, not by lightening their fittings, but by taking weight out of the hull and engines. I think it might be better if we started on the other tack and put in lighter fittings. I think there is one principle that ought to be kept in mind in trying to save weights in that way, and that, as I have heard Mr. Wetherbee express it, although he did not say it here in this paper, was that the best way to save weight is not so much by cutting down the size of any particular individual thing as it was to make that individual thing strong enough to make it add to other and indifferent things. It seems to me that is the best way to get at that in many cases. I also think that in our past and present construction we have not kept the smooth water and the rough water boat distinction enough in mind. Most of the boats have got to go to sea, as Admiral Bowles says. I do not think they have got to go with the fleet, but the question of harbor defense, as expressed, is perhaps rather misleading. A harbor defense boat is a boat that has to work around the harbor, and not only to keep foreign ships out, but to go outside and drive them off. As soon as a boat gets outside it doesn't really make much difference whether she is five miles from the coast or fifteen miles or fifty. If there is bad weather, that is the time she has got to get out, as I understand it. There are two or three little details that have struck me that go to show the truth of this. For instance, the open hotwell proposition works beautifully, and is very satisfactory on trial runs, but you get out in a sea way, it throws all the feed water out in the bilge, which is not satisfactory. In the same way I am a little doubtful about the scoop condenser. It scoops all right in smooth water, but if you get out in a moderate sea with head to the weather and slow speed, the water does not come into the scoop very well. I found that the mouth of the scoop was alternately lifted above the water slightly and then buried deeply, and I think unless some other means of making it good are

provided it is very unsatisfactory. I think for that reason that our boats ought to be designed more with rough water service in view even if they have a comparatively short radius.

As for the question of easing weights by leaving out things, I think we all realize that there is a great deal that might be done, and in one paragraph Mr. Wetherbee alludes to the engineer's force allotted to torpedo boats. Simply make the comparison between the force I have on board the *Bailey* at present and the force the contractor ran with. He ran fifty-six men to the engine room force. He spent considerable time in training them before he did it, too. I have thirty. When they came aboard last summer there was not one of them who had ever seen a water tube boiler of a torpedo boat engine before. I am not certain that my presence below would have brought the work to perfection. I did not come up through the water tube business myself, unfortunately for me. I see Mr. Wetherbee says that ash ejectors are probably useless. I have found that a good way to get rid of ashes at sea is to get them all ready, have a little whip handy and dump on the deck alongside of the hatch, and that was all we had to do with them. We had more trouble in keeping the men there than we did in making the ashes go. To go back again to the rough and smooth water question as affecting the matter of steering, there seem to be two points about that. One is that if you want a boat which you can handle quickly, one that will turn readily in her own length, you have got to use the present type with the cut away flat bottom aft. A boat of that description goes around very quickly and is very handy. But you take the same boat out to sea, especially with following waves, and she goes around very nicely, too. Recently we left New York to go to Port Royal. I told the other officer that was with me that we took our departure from Sandy Hook Lightship and stood out south, practically it was within six points of it, and the compass was doing four points more on its own responsibility, so I was not sure of our locality until we fetched up at Port Royal. Hatches that are essentially tight in smooth water are not necessarily so in rough water. A hatch to keep the rain out won't keep the sea out. Bunker plates and so on that are tight in a smooth water run cease to be so if the ship works a little. Again, fittings like rail and awning stanchions that are strong enough for ordinary conditions, when a heavy man is thrust against them in a sea way, they buckle; not the stanchion itself, but very likely the supports. It seems to me that we have got to go into that business and make the things stronger for sea service. I do not see how it can help resulting in a diminution of speed. I think we have run above the strong speed; that when we get our thirty knots we are coming near to the smooth water basis; if that is what we want we have got it in certain cases. But I think we would better drop the speed and put in enough weight to make the boat sea going.

NAVAL CONSTRUCTOR D. W. TAYLOR: I should like to say a word or two on this valuable paper. I see Mr. Wetherbee has raised one point concerning which we are old antagonists, and as I think there is something to be said on the other side I will make a few remarks.

What I speak of will be found on page 11 of the paper. Mr. Wetherbee objects to the use of stronger steel in conjunction with the ordinary mild steel. In the particular case to which he refers the combination was this (making a sketch). That was somewhere near the section of the boat, this being the coal bunker. Nickel steel was used. Of course the nickel steel has an ultimate strength and an elastic limit much higher than the other material with which it was associated, and Mr. Wetherbee's point at first sight seems to be well taken. But when you consider the conditions existing I think there is something to be said in favor of the combination shown. In the first place the deck of the boat between the bulkhead is a good deal diversified with companions and hatches; the strength is very much reduced naturally, so that you cannot count on an area like that; you must count on big holes here and there which take away a large part of the strength. In addition, that part of the boat is more subject to the vicissitude of heat. If you take a piece of steel and heat it about 55 degrees Fahrenheit it will stretch as much as if you gave it a tension of 10,000 pounds to the square inch. The natural result is that in case of tension, which has to be considered as well as compression, if you have steam up, the center part of your boat is already somewhat stretched so that there is a reasonable supposition that the nickel steel and the mild steel will reach their elastic limit in tension very possibly somewhere about the same condition. Of course the strains which Mr. Wetherbee refers to I think he will agree with me are largely conventional; that we cannot determine by placing a boat on the crest or hollow of a wave what the exact strain is. It is very largely a matter of convention, and we must be governed in this respect very much by practical experience. So far as I know in practically every case where torpedo boat destroyers or these larger boats have given trouble as regards strength, it has been in the deck, and not compression or tension. We have had very little experience in that line ourselves, because we have just begun building them, and accurate information with regard to foreign boats is difficult to obtain. But I know of several instances which are fairly authoritative where these boats have given a great deal of trouble with the upper deck as in the recent case of the *Cobra*, which broke in two. There is some question as to what gave way first, but there is very little question of the fact that when the Admiralty thought it necessary to strengthen her they put seven tons in the deck and not down below, which shows that they considered the deck required the most strengthening. Mr. Wetherbee has shown some diagrams here to introduce some of the results of the model basin experiments and I think those results for boats of this type at this extreme speed have a good deal of interest and show how fallacious some of our old ideas with regard to resistance were. We used to think a few years ago that the resistance varied about as the square of the speed and the horse power as the cube of the speed. So what I have done is to calculate the powers according to which the resistances were varying and to plot the results as curves. You will see that the index of effective horse power starts in at about 3.34 at 11 knots, falls

down to about 3.3-10 at 14 knots, climbs up again to over 4 at 17 knots, and then falls off steadily the rest of the way up to 30 knots. The indicated horse power index starts in a little below 3 as a minimum at about 14 knots, rises to maximum at about 18 knots, and then proceeds to fall off until at 29 knots the index is about 2.4-10, showing that the resistance, instead of varying with the square of the speed, was varying as the one and four-tenths power of the speed. That shows one reason why these boats drive so easily at the higher speed. A peculiar feature about those is that either curve taken alone would throw some doubt on the result. We also used to think that the propulsive co-efficient was constant, the same fractional power was devoted to propelling the ship. We know now that that is not the case. As a matter of fact, even if this curve were somewhat materially out, we know that its general character is correct. Of course this propulsive co-efficient was calculated on the bare hull, and the actual propulsive co-efficient would be somewhat effected by the scoops, et cetera. In trying to find out the reason for these peculiar features I came to the conclusion that they were due almost entirely to the longitudinal distribution of the waves which a boat makes. We find that at 12 knots there is a bow wave which I will for convenience indicate directly at the bow, and the next crest of the wave comes just amidships, and the next crest of course comes at the stern. The result is that at 12 knots the bow wave is re-enforcing the stern wave, and you have the maximum wave distribution, and the resistance counts up more rapidly. That is the actual fact from observation of the distribution of the waves along the side of the model, and that is reproduced exactly to all intents and purposes on both sides of the ship. As the speed increases these waves lengthen and that crest moves aft, and it so happens that the length of this wave corresponds to the ship at almost exactly 17 knots. In other words, this bow wave can reinforce the stern wave at 17 knots. Of course, at a certain speed between 12 and 17 knots, probably at about 14 knots, the hollow at the bow wave combines with the crest of the stern wave, and you will get the minimum interference, and you will naturally expect the curve of resistance to fall off. In the actual curves we get these humps and hollows; these are very marked in the larger ships. But in the curve of the torpedo boats we do not as a rule get the humps and hollows. We get little flats on the curve. You will see that the index is a maximum at 17 knots and a minimum about 14 knots. It proceeds to fall off after that, and the reason is there are no more crests to travel aft. What happens as the speed is increased beyond 17 knots is that this hollow moves aft more and more, and tends more and more to pull down the stern curve, and you never get another lump on that curve. You never get another coincidence of the crests of the bow and stern waves. There is another little point in this connection which shows the accuracy of these results. This curve of slip per cent was apparent slip, not actual slip, but it bears a pretty fair relation to it. You will see that it reaches a maximum about where these curves of index cross the value 3. In other words, we all know that the thrusts of the propeller as the speed increases vary as

the square of the speed; and if that were absolutely true, and if the index were 3, we should find, supposing the co-efficient also remains constant, that the slip would remain constant. You see it comes to a horizontal line and tends to remain constant; also as the index falls below value 3 the slip falls off. If the Society has no objection I will furnish a small scale to this.

NAVAL CONSTRUCTOR LINNARD: Mr. Chairman, I have been engaged recently in seeing how this simplification of torpedo boats could be done. Like a great many others, I am fond of simplicity, but I find that simplicity generally consists in leaving out the other fellow's things and adding a few of your own, so I am afraid it is not so easy as it might appear to leave out those things, because everyone is interested in making his own part secure and letting the other fellow shift for himself. We all know that any structure of this kind is the result of many minds working together, and that no one can fully grasp all the details of the whole thing, and the tendency is to multiply those details which you think on your part are necessary and every one engaged in the operation does likewise, and the result is an accumulation of things which when you glance at them as a whole appear very unnecessary. It can only be remedied by having some reconciling authority of broad view to put an arbitrary fiat on the leaving out or the diminution of these items. The question of the relative dimensions involved in these curves is one that occurred to me. It would appear that, as I understand Mr. Wetherbee's curves, they are deduced from similar models. Now as the absolute dimensions deduced from the model increase, all the dimensions increase, presumably proportionately, and we know that in that case the linear dimensions and the metacentric height are also increased proportionately, and, as you proceed with smaller ships, are diminished. At the same time the tendency would be in the smaller vessels to raise the center of gravity still further decreasing the metacentric height, and I would ask Mr. Wetherbee whether any account was taken of that fact or whether it was within the limits considered immaterial. Mr. Wetherbee advocates shortening these ships and proposes thereby to get an increased speed. It reminds me a little of the Irishman who was offered a stove that would save half his fuel and he said he would buy two and save the whole of it. I would like to know whether Mr. Wetherbee considers this limit of eight to one the shortest one that is possible or whether he would go further under certain conditions.

MR. THEODORE LUCAS: I should like to draw attention to the curve of Mr. Taylor's showing the index for effective horse power, that a maximum occurs at 12 knots when the ship is precisely at the trochoidal wave, and that the minimum of the index will occur about 14 knots where the length of the boat is one and one half times the length of the trochoidal wave, that a maximum occurs when the length of the ship is precisely the same as the length of the trochoidal wave, that there is a maximum at two times, while a minimum occurs at one and one half times and quite likely at two and a half and three and a half further out.

Apparently there are no humps or hollows any more. I think a general law can be deduced from that, and I have formulated it in an article published. This is from Froude's experiments. We all remember those famous experiments about having the length of a ship of 80 feet fore-body and 80 feet after-body. Froude took this body and afterwards inserted middle body and noted the humps and hollows in the curve of wave resistance. The former always occurred at an even multiplication of the length of the ship, while the minima occurred at one and a half, two and a half, three and a half times the length of the ship. I think a general law can be deduced from that, approximately correct, and give a good deal of clue where the constant hollows would occur. I should lay more stress upon the index of effective power in this connection, because it is far more accurate, I believe, in the tank that it can be for the indicated horse power where a good many varying conditions may enter.

In Mr. Wetherbee's paper he speaks of the form being as nearly circular as possible; that that gives the best strength. Now, I believe in our torpedo boat design we are limited quite a good deal in draft and it is often a question if it is not perhaps better to take a little fuller midship section and a flat deck and gain a little more inside room as well as more displacement near the midships part of the boat and make up for the lack of strength that Mr. Wetherbee states is in flat surfaces by a little additional material and stringers that would stiffen the structure. I believe in many cases these round sections have given too little displacement to the ship.

COLONEL STEVENS: The only question that arose in my mind was one that was suggested by some experiments with these flat stern vessels—whether any of the officers who handled them had any experience in having them towed in a seaway. My own experience of that has been that even with very small sea, as soon as the propeller stops turning it is almost impossible to steer the vessel at any speed at all. I should think that in a sea way if one of those vessels got unmanageable she would have to look out for herself; no consort could take her in.

THE CHAIRMAN: I would like to ask Mr. Wetherbee in his reply, which he will make in a moment, where he speaks about the importance of having the main machinery as simple as possible and getting rid of extra appendages, etc.,—of course on general principles we all agree with that—but in another place somewhere he referred to the fact of the importance of trying to get economy in the engine; not to simply drive the life out of the boilers. We all know that that brings up the question of difference between Mr. Normand's method of doing it and the way that all the rest of the torpedo boat builders have done. Normand has always laid great stress on the economy of the engine. The others have used a quite simple engine and not very economical, and forced the boiler enough to get the speed. I would ask Mr. Wetherbee whether in getting this extra economy in the engine to say whether some of this simplicity would not have to be to some extent sacrificed. I ask that because from my remembrance of what I have read about Mr. Normand's method of getting the economy there were cer-

tain things that nobody else had ever put on an engine; so it would seem as though the two were somewhat opposite.

MR. WETHERBEE: Mr. Chairman and gentlemen, of course my gauge of the value of a paper is the extent to which it provokes discussion, whether it is pro or con. It is the discussion we are after, and I think I had best answer a few of the questions that have been asked without expressing any opinion on a large amount of the discussion that has been given. I wish to thank Admiral Bowles for his very kind reception of this paper, and in his stating that he dissents from the basic idea of the new design I think that he is laboring under a misunderstanding. I do not propose to design any more boats for harbor boats. I think it is safer for the lives of some of our men if we keep those we have for harbor defense and build a type of seagoing torpedo boat, which is the boat we recommend. In my opinion, the ratio of eight to one in length of beam is all that is safe to go in a small boat. To put my idea in a few words, I propose that we design torpedo boats still in this country, and that they be built for seagoing work; that we obtain the seagoing qualities by reduction in the ratio of length to beam and consequent increase of strength, and also by increasing the scantlings, both of which are done at the expense of speed in smooth water; but these boats to be seagoing boats to go with the fleet.

I am pleased to note the way the members agree with me on this matter of having some one head responsible for decisions on matters relating to various points.

Concerning Mr. Taylor's remarks about the nickel steel in the midship section which he shows there, if he does not agree with me in the matter of the greatest stresses being compression stresses in the deck, all my argument falls to the ground. I cannot meet him on that. But it strikes me that even with that midship section there if you neglect the center of the deck entirely she is too weak even with the steel.

In regard to Mr. Linnard's question about the metacentric height, there has been very little difficulty in obtaining sufficient metacentric height since we departed from what might be called the toothpick stern model. Since we have gone into the broad flat stern, in fact the metacentric height on the narrow boat with the broad flat stern is enormous. On the Normand model which we adopted the metacentric height is 1.9 feet loaded, and it must be ample for all requirements. Of course, using a less ratio of length to beam, which I advocate, would go to increase the metacentric height in all sizes of boats, provided the weights are the same. It is a very easy matter, however, to reduce the metacentric height, as we all know.

Concerning the remarks of Mr. Lucas about the square midship section and the flat deck, I can only say that in most torpedo boats the propellers dip anywhere from two feet to four and a half feet below the keel, so I cannot see any objection to giving them considerable dead rise. Concerning the stability of the French boats, these boats that gave the trouble were of an older model, before the round section was adopted.

The boats have a very wide range of stability. Stabil-

ity curves show that the stability vanishes at an angle between 90 and 100 degrees. Of course the fastenings for the boiler and the machinery would probably vanish before the boat gets over that far. So I think they are all right.

In reply to Colonel Stevens regarding towing, we have had considerable experience in towing these boats, and the Navy Department has also done some towing under very difficult circumstances. You all probably know that the bow of the *Craven* was smashed off by collision with the *Dahlgren* a year ago, the first two compartments being bent over and set at right angles to the center line of the vessel. The big wooden fender around the *Dahlgren* saved her from being cut in two. The boat was taken back to the torpedo station at Newport. The accident happened within six or eight miles of there. It was decided to tow her to Portsmouth for repairs. The boats were supplied with a shackle in the bow, which is fastened into cleat plates that are riveted to the sheer strakes. At first it was thought they would tow the boat stern first. I advised that that should not be done as they are very low in the stern and suggested that the boat could be towed by fastening to this shackle in the bow and that a pull on the tow line would straighten the bow out. They are very much like an accordion—those boats. It worked beautifully. They towed them from Newport to Portsmouth without any difficulty whatever, in the fall of the year, when the weather was not very good. In regard to our own experience we have been in the habit of delivering the boats from Bath, Maine, to Portsmouth, New Hampshire, a distance of 72 miles, all done by towing. The *Bagley* and *Barney* were delivered in this way together. They have the towing shackles the same as the others, in the bow, and a ring in the stern. A hawser was fastened to them. The propellers were blocked so that the engine would not run and cut the cylinder. Under these conditions we found that no steering whatever was necessary, that the track of the propellers being so far aft and the pull of the tow line being right at the bow kept the boat in a perfectly straight course. She followed the tug beautifully. I will add that the engineer of the tug, who had recently towed two of those large six masted schooners, said that those two boats pulled harder with the propellers blocked than the six masted schooners did.

In reply to Mr. McFarland about the economy of fuel and the arrangements of the engines that are used to obtain this economy, I do not think that any complication is involved. I had an idea that the method used was generally understood or I would have explained it more thoroughly before. There is a separator on the main steam pipe at the throttle of each engine. From the bottom of this separator a pipe leads to the top jacket of the high pressure cylinder. I might add in parenthesis that all the cylinders are jacketed, and that they are all jacketed with boiler steam on both heads and bottoms, with the exception of the low pressure cylinder, which is jacketed with steam from the intermediate steam chest, which has a maximum of about 100 pounds on the barrel for the reason that the boiler steam would require such exces-

sive thickness of cast iron barrel. This separator that I was speaking of delivers this mixture of water and steam at the bottom through a pipe that runs to the jacket on the high pressure head. That jacket drains to the high pressure barrel jacket, which in turn drains to the high pressure jacket. This in turn drains again to the jacket of the head of the intermediate cylinder which drains down through the barrel jacket and then to the head of the low pressure, and from the head of the low pressure to the bottom of the low, not going into the barrel jacket for the reason I previously gave. The steam then goes into the separator and is used to drive the blower engine. That is the secret of the thing; because you would not get your steam and water to run up hill as it has to do in several places through the engine there unless you had a heavy current of steam going through. This also has the advantage of making a constant current of fresh steam going through the jackets and avoiding any air pockets that are liable to occur in steam jackets fitted in the ordinary way. And that steam drives the blower engine, and we can turn the exhaust of the blower engine again into the low pressure chest if we care to, or into the condenser, so you see that the steam has to work for a living before it gets through.

THE CHAIRMAN: I had an impression that he went into the matter of compression very fully, that he had some sort of safety valve on the steam chest to avoid getting too great pressure in it.

MR. WETHERBEE: He uses a very high compression, but there is no complication connected with it because the valve has been in use by many other people, and it simply consists in having a relief valve in the steam port, a relief valve from the cylinder into the preceding steam chest, so that if you get compression above the chest pressure this valve, which is only loaded with a very light spring, will lift and let the cylinder compress back into its own steam chest, and that serves the function of a relief valve. There are no relief valves on the cylinders so that there is no complication involved there. There are ordinarily relief valves on the steam chest of the intermediate and low, which you would have in any case. Then he uses a feed water heater which I do not think is very complicated, a feed water heater sometimes known as a dead end heater. The steam for heating it is taken from the low pressure steam chest. The feed water is pumped from the feed pumps which are coupled to the engine, through the heater, to the boiler. This feeder is fitted with tubes through which the feed water is pumped, and the tubes are fitted with retarders, and with the ordinary steam pressures that we get in the receivers of those boats, from eighteen to twenty-one pounds, the feed will be heated 200 to 240, as it goes into the boiler, so that the heater is remarkably efficient. I might say that the heater has one foot of surface for every 15 horse power, so that they are not large. In conclusion, I wish to thank all the gentlemen who have entered into the discussion for the pleasant way in which they have received the paper.

FOURTH TECHNICAL SESSION.

The meeting was called to order on Friday afternoon, Colonel Edwin A. Stevens in the chair.

LATE DEVELOPMENTS IN ORDNANCE AND ARMOR.

BY J. F. MEIGS, ESQ., ORDNANCE ENGINEER, MEMBER.

Abstract.

In this paper the author discusses the developments in ordnance and armor during the past ten years, and their relation to the modern problems of ship design. Especial attention is given to the question of choice of type of gun for the total given weight, having due regard to the points of penetrating power, quickness of fire and total weight of metal thrown. To quote from the author's summary of the paper: "In the past ten years, by the use of better mixtures, by improved heat treatment, and by very marked improvement in face hardening, the power of armor of a fixed thickness to resist penetration has increased about 40 per cent, while its power to resist cracking has been increased in even greater degree. This has been taken advantage of in large measure in a reduction of the thickness of armor plate on a ship's side. The total weight of armor carried is not less than formerly, and indeed it is perhaps greater than it was, but it is more spread out, and, while the protection on the vital parts is as good and perhaps better than it was, there is now some weight in armor left to cover parts that formerly were without protection.

"Gun steel also—and in speaking of gun steel we may include the steel for shafting as well—has been materially improved in the period under review. The shafting steel now going into ships is very much stronger than that which was used ten years ago. It is, indeed, perhaps quite 70 or 80 per cent. stronger than the former material. The advance in gun steel has not been so marked, because ten years ago the purchaser of gun steel wanted an elastic strength of about 40,000 pounds, whereas only 28,000 or 30,000 pounds was asked for in shafting. Now they both run 50,000 pounds, or even more. These very desirable and very material advances in quality have been rendered possible by the adoption of more satisfactory mixtures in the melting furnaces, and by more skilful heat treatment. They have not, however, been accomplished without much experimentation and the expenditure of a great deal of thought and money. The noted advance in the strength of gun steel has not been followed by a reduction in the thickness of gun's walls. Indeed the gun's thickness is rather greater perhaps than it was, and the increased strength serves only as an additional guarantee against disaster.

"When we come to what may be called the tactical aspects of guns and armor, we find also material changes. The quality of the gun steel and of the armor, as is stated above, has advanced by perhaps 40 per cent, and full advantage has been taken of this in design. The modifications in design which have come about have been numerous. The armor is more distributed. It has come to be recognized that unprotected guns have no chance, and that 6-inch and 12-inch guns should be protected, respectively, by 6-inch and 12-inch armor. It should be noted that this means, if battleships are to penetrate each other, that ships must approach within 1,000 yards range in combat. This brings us back to the fighting range of old

wooden ships, very nearly, for they had to approach within about 600 or 700 yards; and, when we consider that a battleship's 6-inch guns must have normal impact to perforate the armor protecting the 6-inch guns of their opponents at 800 or 1,000 yards, it may be said that the fighting range of ships has not so very materially altered in the past hundred years."

The next paper, in the absence of the author, was then read by the secretary.

RECENT EXPERIMENTS IN ATTACKING ARMOR WITH HIGH EXPLOSIVE SHELL.

BY E. B. BABBITT, CAPTAIN OF ORDNANCE, U. S. A.

Abstract.

In this paper the author gives an account of recent experiments carried on by a committee of the United States Army Ordnance Board regarding the possibility of safely firing shells containing a bursting charge of some form of modern high explosive in the ordinary gun and by the use of the usual powder, such explosive being further required to remain unexploded upon impact with armor or due to the shock of piercing an armor plate, but to admit of complete detonation by fuse after passing through.

The author gives the various requirements which such an explosive should possess and gives the results of series of experiments connected with the search for some form which would meet the requirements. As shown by the results of these experiments two explosives have been found which seem to promise success. These are Maximite and Explosive "D." In the final test 12-inch shells charged with these explosives were fired at and through some armor plate of thickness varying from 3 to 12 inches. In the case of the 12-inch plate the shell did not succeed in getting through the plate, but penetrated and then burst, completely demolishing plate and backing. In the other case the shell penetrated the plates and burst in the rear. A most important item in the successful outcome of the experiments is the fuse for denoting the explosive. The details of this fuse are carefully guarded and it is therefore only referred to in general terms.

DISCUSSION ON THE PRECEDING TWO PAPERS.

LIEUTENANT WHITE: Mr. Chairman and gentlemen, I wish to say in regard to the first question that there is really a great deal more for the mechanical abilities of the people of the United States in the matter of gun mount than appears on the surface in these papers. The 6-inch gun that we have today, you have seen the report of the target practice, is completely man-handled. It requires, however, two men to handle the gun. The practice that has been obtained with that gun has been obtained only because the gun can follow the target all the time while the ship is moving. In other words, you have got to have training gear that will lift the gun fast enough to follow the ship at the rate Mr. Meigs has given so as to keep the gun trained constantly on the target. That is one reason why the 6-inch gun has been so much better than that of any of the higher power guns. Another element of success has been the telescopic sight which is of such power and character that you can almost follow

the flight of the shell from the time that it gets into the field of vision, after it leaves the muzzle of the gun until it strikes the target. Of course with 6-inch guns of that character and type when you get within a range of a thousand yards the vessel that can fire eight shots a minute even from three or four of those guns is going to have an enormous advantage over another vessel that cannot fire so fast. As it will be necessary for vessels to approach the close range of a thousand yards it seems to me that the turrets for the heavier guns are made unnecessarily heavy for the protection that is necessary. If the turrets are sufficient to keep out a six inch projectile up to the short ranges, the possibility of hitting with the larger guns is so reduced that it is better, on account of the manipulation of the heavy guns, to have a lighter turret than to have the extra protection which the heavier turret gives. There is another element in the practice which makes the inclination of the shield also a protection which we do not seem to have sufficiently considered, arranging the gun so that in its manipulation it will take up very little room above the bar-bette. The excess in height must be pared down so as to get as small a turret as possible, and the front of the turret made as low as possible so as to give a gradual slope to the top of the turret instead of having a flat turret. In order to increase the size of the gun, which we find seems to be necessary in order to attack the present protection of the 6-inch gun, we have got to increase our mechanical facilities for handling the heavy gun by hand. It must not be done by machinery and the weight to be moved should not be greater than that absolutely necessary for the gun. In other words, the use of turrets for guns of 8 inches seems to be a mistake. We have so much more weight to handle and so many more complicated things to take into consideration, because a shot which would jam a turret and put two 8-inch guns out of commission might not have any effect at all on a single gun behind a casemate protected as 6-inch guns are. In regard to the ammunition supply it seems to me absolutely necessary that each 6-inch gun should have its own separate magazine, and I think that the reason that the reported English target practice has been so successful is that the English carry their projectiles immediately near the gun, and all that has to be handled is the powder. That very materially reduces the work in hand. In regard to the practice that is made there is some question of course about the target practice whether these results are accurate or not. Of course the conditions of target practice are ideal as a rule. The range is known and there is only one gun that is fired at a time. That you have to do in order to determine the capacity of each individual man using the gun. At the same time that is a basis for comparison, because when you come into battle if the range is unknown on one side it is equally unknown on the other, and when it gets up to a point where it does not make any difference whether the range is 1,200 or 1,400 yards, the man who can fire eight shots a minute is going to do very effective work at the expense of the other man. The reason for having the larger gun, that is not having another battery of one calibre of gun is because in approaching the critical stage where

the secondary battery guns can produce an effect, the heavier guns are supposed to break down part of that defense. In other words, you can penetrate all that part of the ship above the protective decks and outside of your turret by your heavier guns, and before you get into the critical range with your 6-inch gun. The question is now the limit of the mechanical facilities for handling the heavier gun. If you can handle the 12-inch gun with equal facility with the 9.5-inch, the 12-inch is the better gun; but with the 9.5-inch gun if you can get better shots by the manipulation of the gun, it is better to have the lighter gun. That is the reason for the change that has been made in some of the battleships now building abroad.

NAVAL CONSTRUCTOR LINNARD: There is one point in Captain Babbitt's paper which I think will materially affect the design of ships. If it is possible for armor piercing shells to be fired through seven or eight inch armor and explode behind that armor, the casemate system is doomed, and all our guns have got to go into turrets, which certainly afford the best chances of protection under those conditions.

SOME NOTES ON TIDAL CORRECTIONS.

BY EDWIN A. STEVENS, ESQ., VICE-PRESIDENT.

Abstract.

In this paper reference is made to a formula used in standardizing the screws of some of the earlier torpedo boats, and published in the journal of the Society of Naval Engineers. From this formula a somewhat different expression was derived by algebraic change, giving speed in feet per minute as follows:—

$$\text{Speed} = \frac{R_a + R_w}{R_a T_w + R_w T_a} 6080$$

Where

- R_w = number of revolutions on course with tide.
- R_a = number of revolutions on course against tide.
- T_w = time on course with tide.
- T_a = time on course against tide.

The results of the tests of a 30-foot steam cutter reduced according to this formula were plotted and were found to show great irregularity. The following formula was then derived for the mean tide velocity for a pair of runs.

$$\text{Velocity} = \frac{R_a + R_w}{R_a T_w + R_w T_a} C$$

where C = length of course and the other symbols have the same meanings as above. The values of the tide thus found were then plotted on a time axis at the mean time for the pair of runs, and a tide curve thus determined. The corrections thus applied were then found to give satisfactory and consistent results. As a check test a tide curve was assumed and a series of observations made up to represent the results of a progressive trial. These were then treated by the method proposed, and it was shown that the tide curve thus found was in close agreement with that assumed.

DISCUSSION.

MR. PAULDING: In this method of working up the progressive trial trip the curve of the tide is derived

by a method which is about equivalent to the ordinary method of mean speed, and this is used as a first approximation, and the increased accuracy due to the method is because you start with a first approximation and then go on from that and make a second approximation. The practical application of the method as stated in the paper was this: With a 30-foot steam cutter a set of progressive runs was made on one Sunday, and the next Sunday another set was made. In the first plate on the lower left hand corner are shown the two curves, one lying considerably above the other. As stated in the paper, there was no way of accounting for the different results, and this method was then applied and the two curves that light almost one on top of the other are shown higher up on the same plate. This is rather an extreme case of progressive trial. The speeds are very low on account of the smallness of the boat, only 4 1-2 knots at the lowest speed. It is difficult to get accurate results with such low speeds anyway, and I think it is pretty good proof of the value of the paper the way those two progressive trials which at first sight seem to differ so much were brought into co-incidence. The rest of the paper was simply a theoretical case to show the theoretical accuracy of the different methods.

SIDE LAUNCH OF TORPEDO BOATS AND TORPEDO BOAT DESTROYERS.

BY ASSISTANT NAVAL CONSTRUCTOR W. G. GROESBECK, U. S. N.,
MEMBER.

Abstract.

This paper describes the methods adopted at the yard of the William R. Trigg Co., at Richmond, Va., for the launch of the torpedo boats *Shubrick*, *Stockton* and *Thornton*, and the torpedo boat destroyers *Dale* and *Decatur*.

The use of the side launch was due to lack of room rather than choice. The chief differences between the method used here and on the Great Lakes were pointed out, consisting in a different construction of cradle and in carrying the ways down under water so that the boats were floated rather than dropped off. The launches were all successful, and no trouble was experienced beyond some slowness in starting in two cases.

The paper contains full launching data for these vessels, together with plates showing details of construction of the ground ways and cradles.

There being no discussion on this paper the meeting then adjourned.

New Yachts.—A contract has been placed by Mr. Alessandro Fabbri with the Townsend and Downey Shipbuilding and Repair Company of New York, to build from designs by Cary Smith & Barbey, naval architects, a steel auxiliary schooner yacht, 77 feet W. L., this yacht will be when completed one of the most elegantly furnished of her class and will reflect credit on the American yachting fleet. This company has also under construction two large steel schooner yachts, one for the German Emperor, 120 feet W. L., from designs by Cary Smith & Barbey and one 110 feet W. L., for Mr. Gibson Fahnestock of New York, from designs by Theodore Ferris.

FIGUREHEAD AND ORNAMENTS FOR THE U. S. CRUISER CINCINNATI.

The figurehead as an ornamental feature of ship design and construction comes down to us from the earliest times. Especially with the famous clipper ships as well as the war ships of a half century and more ago was the figurehead an important ornamental feature. With the passing of the wooden ship and the advent of steel, the figurehead has almost entirely disappeared, especially on modern steel warships. A pleasing revival of this old custom has recently been inaugurated on the United States Cruiser *Cincinnati*. This cruiser was built at the New York Navy Yard in 1893-4, the sister ship *Raleigh*, being built at the same time at the Norfolk Yard. These two cruisers, together with the *Texas* and the first *Maine*, were the only ships in the modern steel navy built in the government navy yards. The *Cincinnati* is a second class cruiser with chief particulars as follows:—

Length.....	300 ft.
Beam.....	42 "
Draft.....	18 "
Displacement.....	3,183 tons.
I. P. H. (designed).....	10,000 "

The power intended for the *Cincinnati* was very large, and with Scotch boilers it led to a crowding of boilers and machinery not conducive to the highest efficiency under running conditions. The fire rooms in particular were excessively hot, and various ventilating arrangements were tried with but moderate success. Shortly after the close of the Spanish-American war it was decided to replace the Scotch boilers with water tube boilers, and to make various other changes in the internal arrangements and fittings. These changes have been especially thorough as regards the replacement of wood in the furniture and other fittings with non-combustible material, and it is claimed that the *Cincinnati* is more nearly fire proof than any other warship afloat.

In connection with these changes a return to the good old custom of fitting a figurehead has been made and the *Cincinnati* now displays a life size figure of Liberty in steel and wood standing out from her stern. This figurehead was designed and constructed at the New York Navy Yard, under direction of Rear Admiral Bowles, then in charge of the construction department, and is considered to be a most successful example of this style of art. The figurehead with the accompanying ornamental work about the bow, together with the corresponding carving and tracing about the stern, is well shown by the photographic reproductions shown herewith.

Tracing Erasers.—A correspondent of *American Machinist* writes to that paper suggesting a device for making erasures on tracing paper to greatly reduce the time consumed in all drawing rooms to perform this arduous task. He suggests connecting a flexible shaft to the end of a desk fan, and at the other end placing a circular Faber eraser.

This reminds one of our contributors of the revolving hair brush used in some English barber shops, where a circular brush, held in the hands of the barber, is run by a rubber belt on an overhead shaft, to brush the hair of the unfortunate occupant of the chair.

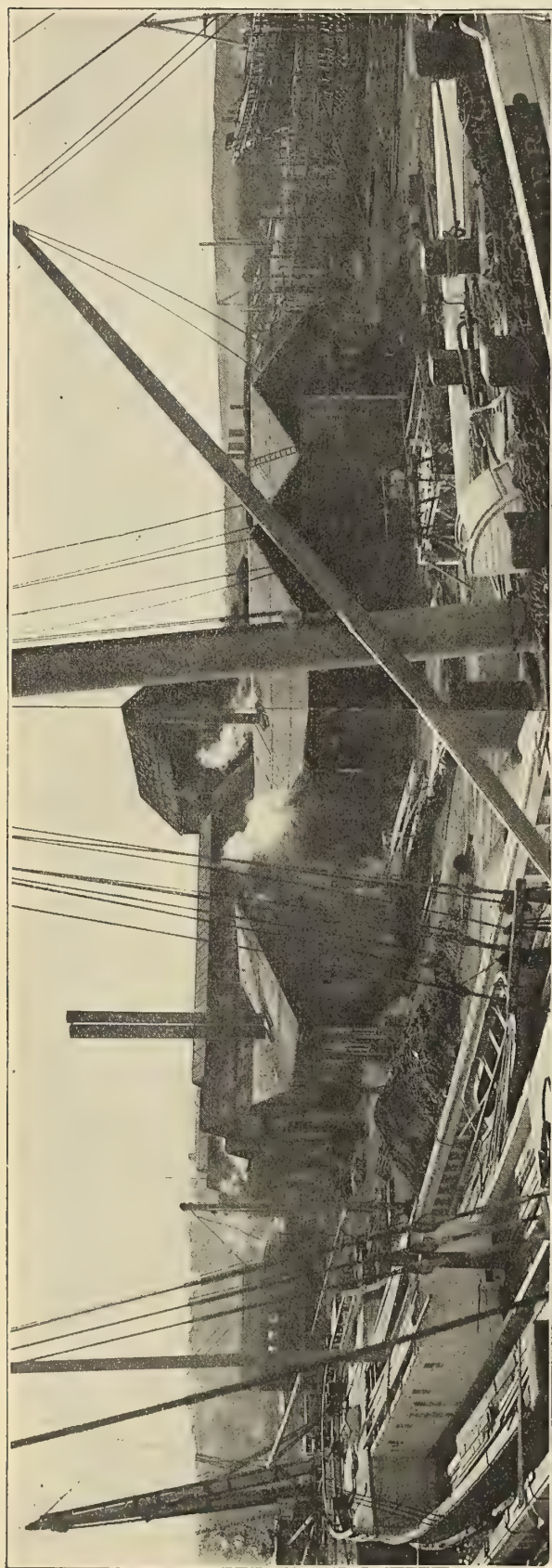


FIGUREHEAD OF LIBERTY ON THE STEM OF THE CINCINNATI.



NAME PLATE AND SCROLL ON THE STERN OF THE U. S. CRUISER CINCINNATI.

Photographed by E. Muller, Brooklyn, N. Y.)



VIEW OF THE FULTON ENGINEERING WORKS.

The Five-Masted Schooner *W. H. Marston*.

Nearly all of the Pacific Coast shipbuilders have turned their attention to the construction of four and five-masted schooners, as this class has been found best adapted for the trade between coast points and Hawaii. The latest addition to the fleet is the five-masted wooden schooner, *W. H. Marston*, built by the Fulton Engineering and Shipbuilding Works of San Francisco. The illustration on the opposite page shows the very heavy construction of framing and keel. She is the largest vessel of her class ever built in San Francisco. She is fitted solely for carrying freight, and has on deck steam hoisting apparatus to facilitate rapid handling of cargo. The principal dimensions are: Length over all, 240 feet; beam, 42 feet; depth of hold, 18 feet, 6 inches.

Since going into service, the *Marston* has proved to be a fast ship, and is easily handled by a small crew.

Development of the shipbuilding industry on the Pacific Coast has been very rapid during the last ten years. The works of the Fulton Company, here illustrated, are on the bay of San Francisco, and have a water frontage of over 1,000 feet. Many improvements and additions have been made at this yard, until now both steel and wooden vessels and machinery are built. The capacity of the yard is increasing annually, and at present 1,500 men are employed.

Knockdown Steamers for the Philippines.—Nine-teen steel steamers have been bought from the Cleveland Steel Canal Boat Company by the Philippine Transportation Company for service in the Philippine Islands. Owing to the time that would be required to tow this fleet of steamers to their destination it has been decided to take them apart and ship them in sections.

DESIGN OF ENGINES OF VARYING POWERS FROM ONE SET OF DRAWINGS.*

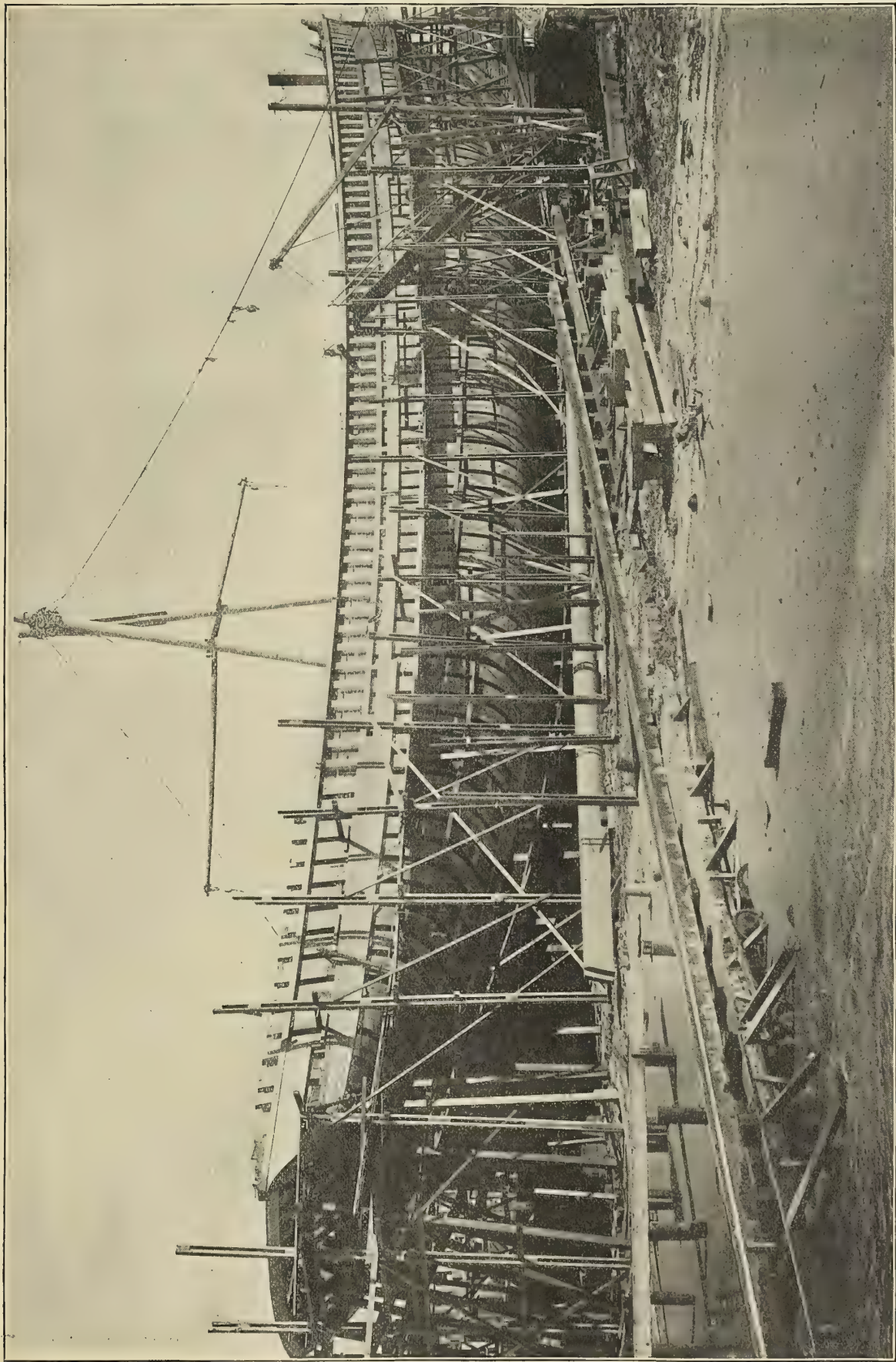
BY PROF. H. C. SADLER.

II.

In the last article we saw that in order to obtain the dimensions for a new engine from one already designed, we had to multiply the original dimensions by the square root of the ratio of the I. H. P.'s.

Let us take as an example a triple expansion four cylinder engine whose cylinders were, say, 19, 29, 31 1-2 and 31 1-2 inches by 30 inch stroke. At 190 revolutions this engine developed 3,800 I. H. P. The piston speed was therefore $2.5 \times 190 \times 2 = 950$ feet per minute. The new engine is required to develop, say, about 10 1-2 per cent more power, or, say, 4,200 I. H. P. The ratio of the horse power is then $4,200 \div 3,800 = 1.1052$.

*Continued from Marine Engineering for November, p. 464.



PACIFIC COAST WOODEN FIVE MASTED SCHOONER W. H. MARSTON.

(Photographed by E. Muller, Brooklyn.)

The factor by which all dimensions must be multiplied is therefore $\sqrt{\frac{4200}{3800}}$ or $\sqrt{1.1052}$, or, say, 1.0513.

Hence the diameter of cylinders will be:

H. P. = 19 $\times$ 1.0513 = 19.975 or say 20 inches.

M. P. = 29 $\times$ 1.0513 = 30.487 or say 30½ inches.

2 L. P. = 31½ $\times$ 1.0513 = 33.116 or say 33 inches.

Stroke = 30 $\times$ 1.0513 = 31.53 or say 31½ inches.

We saw above that the piston speed must remain constant, and hence the revolutions of the new engine

will be $\frac{950}{2 \times 2.625} = 181$. The new engine then, with

cylinders 20, 30 1-2, and two of 33 inches by 31 1-2 inch stroke will develop 4,200 I. H. P. at 181 revolutions.

We may now proceed in the same way to alter all the other dimensions of the various parts. Take for example, the working drawing of a connecting rod. The original drawing has upon it all the necessary dimensions, such as distances between centers, diameters at various points, etc. All these dimensions must be multiplied by the same factor as before (in the case cited 1.0513), and we shall then obtain the dimensions for the connecting rod of the new engine. The same process is gone through with all other drawings.

Turning now to the cylinders and valves, one of the first points to be settled is the size of port openings. The sectional area of ports and passages is usually so designed that the speed of the steam through them does not exceed a certain amount. Now, when we increase the diameter of the cylinder and keep the piston speed constant, the volume of steam per minute will increase as the area of the cylinder, or as the square of the dimensions. If all the dimensions be increased the area through the ports and passages will increase as the square of the dimensions, for the length and breadth are both increased. Suppose, for example, we allow a speed of steam of say 6,000 feet per minute, the area through the ports = area of piston $\times$ piston speed $\div$ 6,000.

If now we increase the dimensions as before 1.051 times, then $(1.051)^2$ original areas through ports = $(1.051)^2$ area of original piston $\times$ speed of piston $\div$ 6,000, or the same result as in the previous case. So far as port areas go, the conditions of velocity of steam are therefore constant. The same thing is true for the valves and port openings to steam. A little consideration will show that since the valve travel will increase as the length of port increases, the same conditions as to distribution of steam will hold as in the type engine.

This may be perhaps more clearly seen if reference be made to the ordinary Zeuner valve diagram. If every dimension be increased, the valve travel, lap and lead will increase in the same proportion. Hence, the angle of advance of the excentric will remain the same as in the type engine, as will also the positions of cut off, release, compression and admission. We have, in fact, simply altered the scale of the valve diagram in the same proportion as the scales of the whole of the plans have been altered.

One other important point to be settled in the early stages of design is the question of the amount of surface that shall be given to the various bearings, guides,

etc. In fixing the amount of surface it is customary to so arrange matters that the pressure per square inch does not exceed a certain amount, the magnitude of this being chosen from more or less practical considerations.

Now we have seen that the load varies as the square of the dimensions, and if the scale is varied as above, all the surfaces will vary as the square of the dimensions. Hence the pressure per square inch will remain the same, however the scale of the drawing or size of the engine is varied, and consequently the conditions of working will remain the same throughout.

We will now discuss in a brief way the best means of applying the above methods in practical work. It is evident at the outset that if a new set of drawings and tracings are made to the new dimensions, little if any time is saved. Provided that plenty of dimensions are given, so that a piece of the engine can be made directly from the drawing, there is no reason why that drawing should be to any recognized scale, so far as the shop is concerned.

We may then take a tracing from a plan of a part of one engine and fill in the dimensions corresponding to another. Or, better still, if the tracing be left blank as regards dimensions, simply the dimension lines and arrows being shown, and the dimensions themselves filled in on a separate sheet, the two can be photographed together, and the blank tracing is again available for the next design.

This method may be perhaps more clearly seen from the accompanying figures. Fig. 1 shows a tracing of a connecting rod with the dimensions left blank. Over this tracing a piece of thin tracing paper is placed and the dimensions of the various parts filled in (Figure II). Two reference marks may also be added so that the positions of the tracing and the dimension sheet will remain constant. The two may now be pinned together and blueprinted in the ordinary way. For reference the tracing of the piece should contain some number, which should also be placed on the dimension sheet. The dimension sheet only will contain the engine number. It is needless to say that no scale is placed upon either.

The same method may be followed in all drawings. There are, however, one or two points which need attention. In the first place, it will be noticed that to multiply the various dimensions by a decimal fraction practically means that all dimensions should be first converted into, say feet and decimals of a foot, or inches and decimals of an inch. The results for the new dimensions are then in a decimal form. There is no reason why they should not be retained in this form. Mechanics can work as easily in decimals of an inch as in sixteenths or thirty-seconds. It is all a question of a little training. Already some firms have adopted this system and found it to work perfectly satisfactorily. If, however, conservatism is the ruling factor, the various decimals must be converted into the nearest number of feet and inches, and say thirty-seconds. This will entail extra labor in checking up the over all dimensions in many cases.

The only other point in the above method about which care should be taken, is the diameter of the various bolts and studs and the amount of material

around the same. Bolts and studs are usually made in standard sizes, and although the diameter of these as altered when the size of engine is altered, would be sufficient for strength purposes, from the general point of view of manufacture and repair, it is as well to adopt standard sizes.

The general theory of dimensions also holds to a certain extent in connection with propellers. The surface of the propeller is usually proportioned with respect to the horse power. If the diameter of the propeller be altered in the same proportion as the dimensions of the engine, the surface will vary as the square of the diameter or dimensions and as shown above the I. H. P. varies in the same way. If the pitch also be altered, or vary as the dimensions and the piston speed remain constant, that is, the revolutions vary inversely as the dimensions, the speed of advance of the propeller will be $p \times r$ (where p = pitch and r = revolutions), and this will vary as $d \times r \div d = r$. That is, the speed of advance remains constant, and if the speed of the ship remains constant the slip will also be constant.

Hence for a given form and speed of ship, the above rules will apply to propeller with a fair degree of accuracy, provided the change in dimensions is not of great extent.

With regard to the amount of space required and the weight of engine, these may be estimated at once from the original plans. Since we have increased all dimensions, the space occupied in any direction will vary as the dimensions. Or, for example, if the over all dimensions of the type engine chosen in the above example were, say 20 feet long, 7 feet broad, and 13 feet high, those of the new engine would be $20 \times 1.051 = 21$ feet, $7 \times 1.051 = 7.35$ and $13 \times 1.051 = 13.66$ feet.

The weight of any body varies as the product of the length, breadth, and depth; or, if d represents a general dimension, the weight varies as d^3 . Hence, if W_1 = original weight of engine, and W_2 = the weight of the new one, then

$$\frac{W_1}{W_2} = \frac{d_1^3}{d_2^3} = \frac{(1/\sqrt{P_1})^3}{(1/\sqrt{P_2})^3} \text{ since } d \text{ varies as } 1/\sqrt{P}$$

$$\text{or } W_2 = W_1 \times \left(\sqrt{\frac{P_2}{P_1}} \right)^3 = W_1 \times \left(\frac{P_2}{P_1} \right)^{\frac{3}{2}}$$

Or, for example, taking the same engine as before, the weight of the new engine will be

$$W_2 = 130 \times \left(\frac{4200}{3800} \right)^{\frac{3}{2}} = 151 \text{ tons.}$$

The weight per horse power will increase as the size increases for

$$\frac{\text{weight}}{\text{I. H. P.}} \propto \frac{d^3}{d^2} \propto d.$$

or, looked at in another way, the I. H. P. per ton of engine will decrease as the size increases. The above reasoning does not apply to condensers and evaporators, as the weights of these will vary as the power of the engine.

The method of proportioning the various parts of a type of engine for various conditions as above outlined is a very simple matter, and even if not followed in its entirety, will be found useful in many cases.

Revenue Cutters Nos. 9 and 10.

Bids for the construction of the two small revenue cutters were opened at the Treasury Department on the 12th of October. The following were received:

	No. 9.	No. 10.
Racine Boat Mfg. Co., Racine, Wis.....		\$59,850
Townsend & Downey Shipbuilding and Repair Co., Shooter's Island, N. Y.....	\$79,612	\$91,637
Spedden Shipbuilding Co., Baltimore, Md.....	\$39,600	\$53,100
William R. Trigg Co., Richmond, Va.....	\$57,297	\$62,253

The amount available for the construction of No. 9, exclusive of the boiler, is \$42,500; for No. 10, exclusive of the boiler, \$67,500. The bids of the Spedden Shipbuilding Company, of Baltimore, being the lowest in each instance, were accepted, and contracts have been made with that firm who promise deliveries within twelve months. Seldom are bids received which show so much variance as for example the highest bid for No. 9 was over 100 per cent in excess of the lowest bid received. It may also be an item of interest to note the present advance in the cost of ships. A precisely similar tugboat to No. 9 was built complete in 1893 for \$37,500. The total cost of No. 9 will be \$47,000, an increase of over 25 per cent.

Revenue Cutter No. 9 is a small tugboat intended for harbor duty at Boston, Mass. She will be 96 feet 6 inches long over all, 20 feet 6 inches beam with a depth of hold of 10 feet 3 inches. Her displacement at a mean draft of 8 feet will be 175 tons.

Revenue Cutter No. 10 will be a small vessel for patrolling the Sault Ste. Marie, and regulating the speed of vessels passing through that important thoroughfare. She will be 110 feet long over all, 20 feet 6 inches beam, and have a depth of 12 feet 1-2 inch. Her displacement will be about 215 tons.

The steam machinery of these two vessels will be duplicates. Each will have one Roberts water tube boiler with 72 square feet of grate surface and 2,800 square feet of heating surface. The engine in each vessel will be of the ordinary vertical triple expansion type, with a high pressure cylinder 13 1-8 inches in diameter, an intermediate of 21 inches diameter, and a low pressure cylinder of 32 1-4 inches diameter, the stroke for all being 24 inches. They will be provided with independent air and circulating pumps, but the main condenser will form a part of the framing of each engine. Each vessel will be provided with a distilling apparatus in order to prolong the life of the boilers. It is expected that the main engine and auxiliaries will develop about 525 indicated horse power under maximum conditions.

Electricity in the Navy.—The Navy Department has decided upon making all electrical apparatus for the United States Navy 125 volts. The standard voltage for the past thirteen years has been 80 volts. This change to a commercial voltage will facilitate ordering the necessary apparatus and will reduce the weight of wiring, conduit, etc., used in installations.

EXPRESS STEAMSHIP LA SAVOIE.

A magnificent new ship has been placed on the New York-Havre service of the Compagnie General Transatlantique. She is named *La Savoie*, a sister ship of *La Lorraine*, and was built at the company's shipyard at Penhoet, France. The outward appearance of *La Savoie* is indeed rakish as shown in the first engraving.

The passenger accommodations and appointments are very beautiful and the color schemes of woodwork, painting and draperies are most pleasing. Every detail of equipment to increase the comfort of passengers has been studied and successfully carried out. Most of the first-class cabins occupy the midship and forward part of the main, upper and promenade decks. Most of the cabins are on the main deck. Opposite

on many steamers. They are located aft on the same three decks as the first cabins. The steerage is arranged for 400 persons.

Turning now to the structural details of the hull and machinery, there are six decks and 16 transverse watertight bulkheads. The principal dimensions of the hull are:

Length of keel.....	470.7 ft.
Length between perpendiculars.....	557.6 "
Length over all.....	580.0 "
Beam, extreme.....	60.0 "
Depth moulded.....	39.6 "
Load draft.....	23.4 "
Corresponding displacement.....	15,180 tons
Registered tonnage.....	11,680 "

There are two sets of triple expansion cylinders, four crank direct acting inverted engines placed in separate watertight compartments. The high pressure cylinder is at the forward end, the low pressures in the middle and the intermediate pressure at the after end.



EXPRESS STEAMER LA SAVOIE OF THE FRENCH LINE.

the engine room casings are numerous toilet and bath rooms; a few cabins are aft of the casings, but most of them are forward where also may be found a ladies' boudoir and children's dining room. The main stairway forward leads to a beautiful vestibule finished in mahogany, which is the entrance to the dining saloon, where there are seats for 200 persons. The decorations are bright and cheerful, the light coming in through square ports and a sparkling cathedral glass skylight. Forward are eighteen desirable rooms. Ascending the grand staircase one may enter the beautiful music and reading rooms turning aft, or to the large smoking room at the forward end of the deck house. Amidship and aft are the fine suites of *cabines de luxe*. A complete telephone system connecting each room of officers and passengers with the chief steward's office is installed. In all 466 passengers may be carried in the first cabin.

The accommodations for 116 second class passengers are equal in most respects to those of the first class

All cylinders are steam jacketed and provided with reheating receivers. Stephenson link motion actuates a piston valve on the high pressure cylinder and balanced slide valves on the intermediate and lows. Each cylinder and steam chest is a separate casting and supported on box columns front and back.

The boiler equipment is uniform throughout and laid out in a simple and efficient manner. The steam pressure carried is 162 pounds per square inch. There are 16 single end Scotch boilers arranged in four compartments with a continuous passage way and track for conveying coal from the forward to the after boiler room. Coal is carried in wing bunkers and in a large thwartship bunker between the second and third compartment. The flues from the eight forward boilers lead to the forward stack, and the after stack receives the gases from the after eight boilers. Forced draught of the Howden system is applied throughout, and in each boiler room are four fan engines, one for each boiler.

The leading dimensions of the machinery are as follows:

High pressure cylinder, diameter.....	43.3 in.
Intermediate " "	68.5 "
Low pressure " "	80.3 "
Stroke.....	67.0 "
Crank pin 28 in. long by 21 in. diameter.....	
Bearing surface of the 12 thrust collars.....	24.4 sq. ft.
High pressure cylinder clearance.....	16%
Intermediate pressure cylinder clearance.....	14.4%
Low pressure cylinder clearance.....	15.8%
Cooling surface in condenser per engine.....	16,270 sq. ft.
Boilers diameter.....	17.06 ft.
" length.....	10.83 "
Number of furnaces total.....	64.
Grate surface total.....	1,960 sq. ft.
Heating surface total.....	74,630 "
Number of tubes each boiler.....	526
Diameter of tubes.....	3.9-16 in.
Thickness of shell.....	1.7-16 "
Distance between tube sheets.....	7.74 ft
Volume of water in each boiler.....	1,020 cu. ft.
Volume of steam " "	547 "
Height of stack.....	94.5 ft.
Working pressure.....	165 lbs.

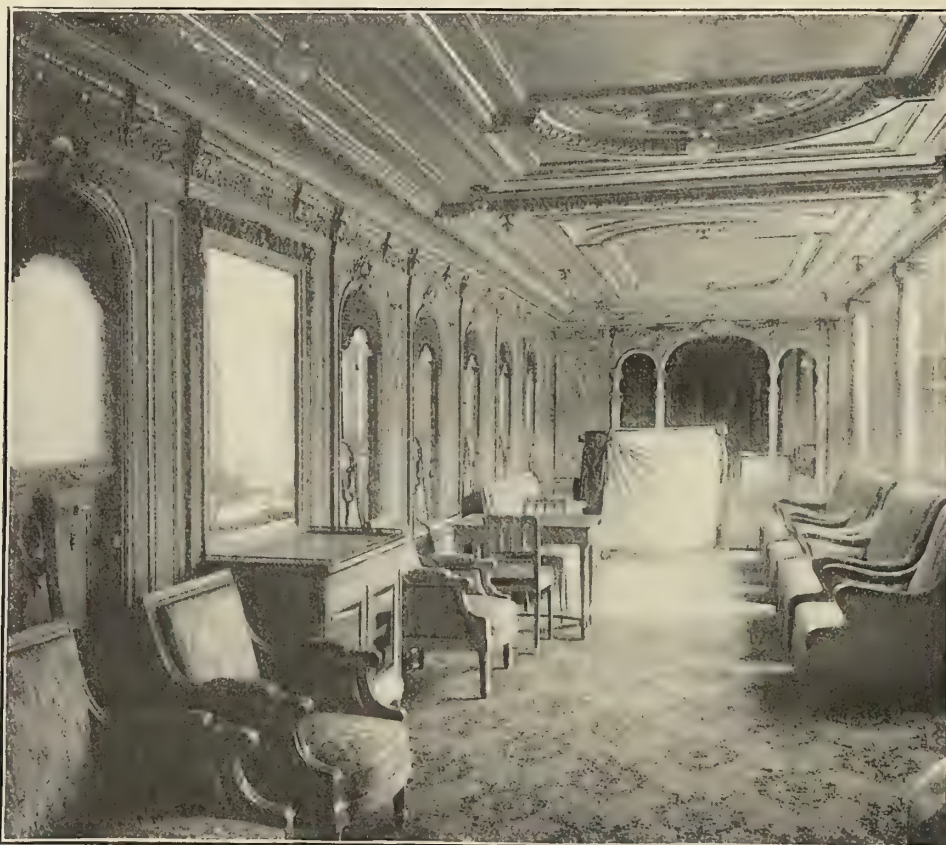
three blades made of Stone's bronze. The pitch is 26.3 feet and the diameter is 21.5.

A table of weights of hull and machinery is here given:

Hull complete.....	7,475 tons
Engines, boilers with water, shafting, auxiliaries, etc.....	3,566 "
Dead weight capacity.....	4,139 "
Water ballast.....	1,200 "
Each boiler dry.....	52 "
Crank shaft.....	37.4 "
Line shaft.....	88.5 "
Pistons and rods, high pressure.....	2,030 lbs.
intermediate.....	3,830 "
low pressure each.....	5,315 "

A speed of 22 knots was made on the trial trip last August, when the engines developed 22,000 I. H. P. at 90 revolutions per minute.

The net cost of *La Savoie* was about 12,500,000 francs, or \$2,500,000.



MUSIC ROOM ON LA SAVOIE

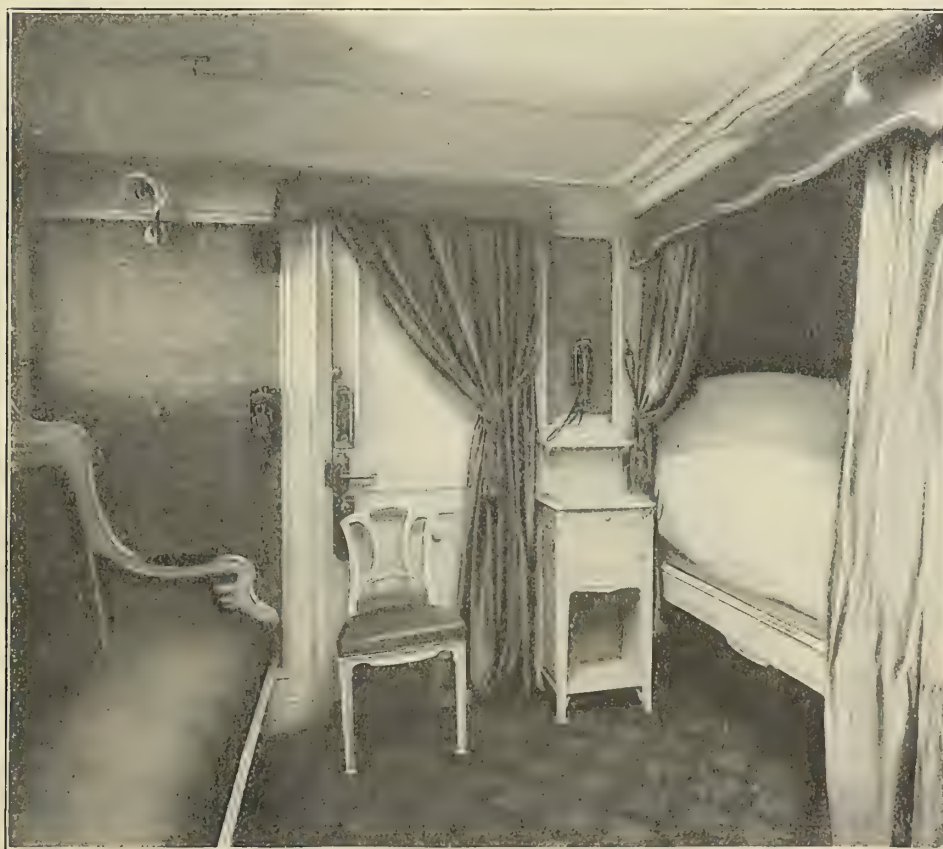
In all there are 100 auxiliaries in the engineer's department, including simplex Blake pumps for all purposes except water ballast, which is operated by Blake duplex pumps. There are two Blake independent air pumps, one for each engine, of the single acting twin beam pattern. The steam cylinders are 16 inches, the air cylinders 38 inches diameter, and the stroke is 21 inches. The condensers are separate from the engine frames and there are two for each engine, one for each low pressure cylinder. The dynamos are driven by DeLavel steam turbines.

The shafting and connecting rods are hollow forged Nickel steel. The propellers have cast steel hubs and

Compound vs. Triple Engines.—New triple expansion engines have been placed in the steamer *Alameda*, of the Oceanic Steamship Company, of San Francisco. It is stated that the gain in dead weight carrying capacity for the round trip will be 1,000 tons. The former compound engines of the *Alameda* had cylinders 43 and 61 inches in diameter by 51 inches stroke, indicating 2,500 horse power at 65 tons of coal a day. The new engines are 29, 47 and 78 inches by 58 inches stroke, indicate 3,000 horse power, and require 56 tons of coal. The former speed of the ship was 13.8 knots, and now she is expected to make 15 knots, showing the superiority of the triple engine.



PRIVATE PARLOR, EXPRESS STEAMER LA SAVOIE.



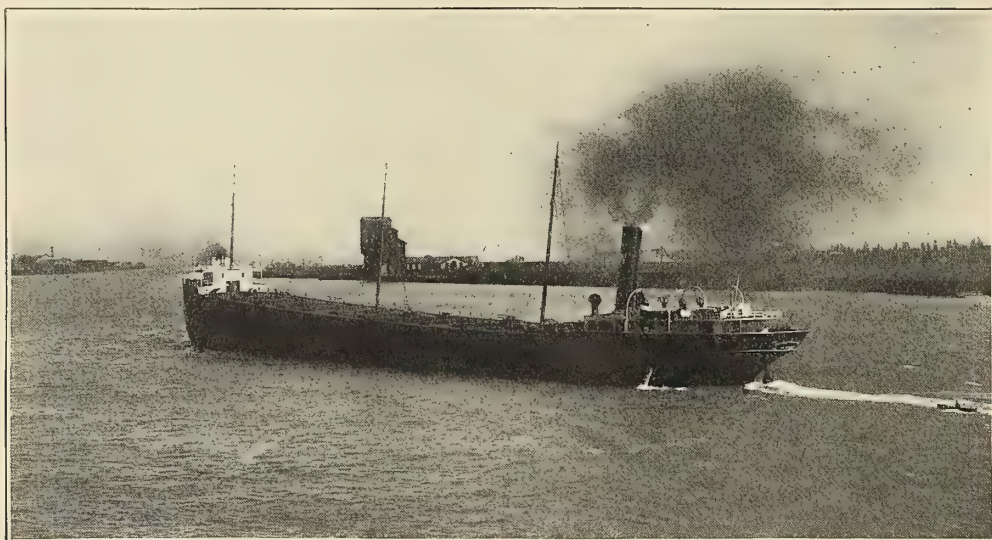
BEDROOM EN SUITE ON THE EXPRESS STEAMSHIP LA SAVOIE.

LAKE STEAMER CAPTAIN THOMAS WILSON.

This ship, which was built for the Wilson Transit Company, of Cleveland, Ohio, by the Jenks Ship-Building Company, of Port Huron, Mich., is of the usual type of single deck bulk cargo steamer now

requirements of the Great Lakes Register—a branch of the Bureau Veritas Classification Society—being built under the supervision of their inspector and received their highest rating.

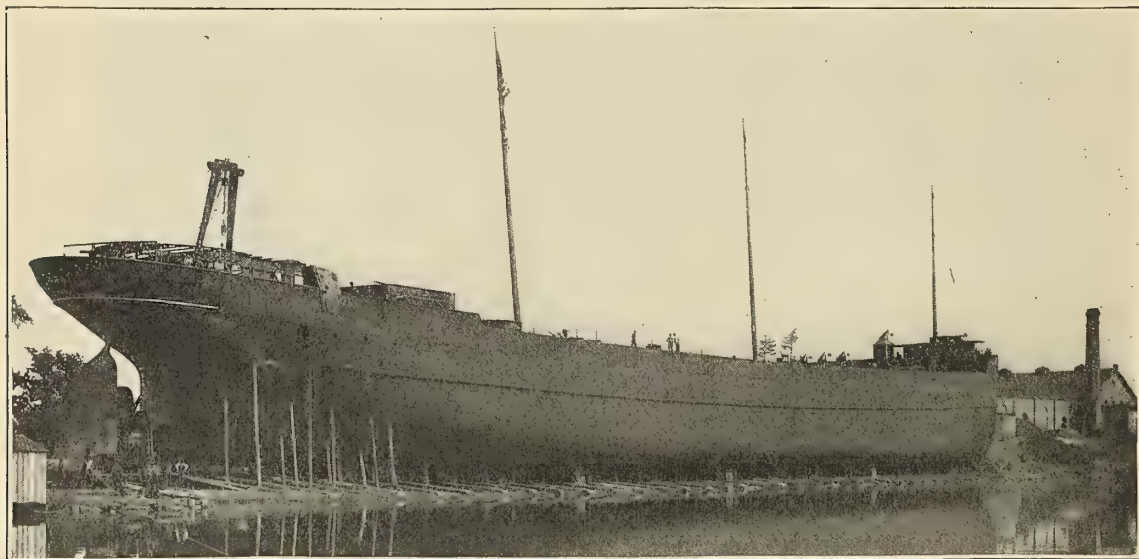
The ship is built throughout on the channel sys-



LAKE FREIGHT STEAMER CAPTAIN THOMAS WILSON.

prevalent on the lakes. The machinery is placed as far aft as possible, with cabins above the same, while the pilot house and Texas are located well forward on the forecastle deck, leaving the spar deck clear, which greatly facilitates the rapid handling of bulk

tem of construction. The floors in the water bottom are 15 inches x 33 pounds channels, spaced 24-inch centers, while the frames above the tank top are of the same scantling, spaced 4 feet centers. The main and upper deck beams are also of the channel section, as



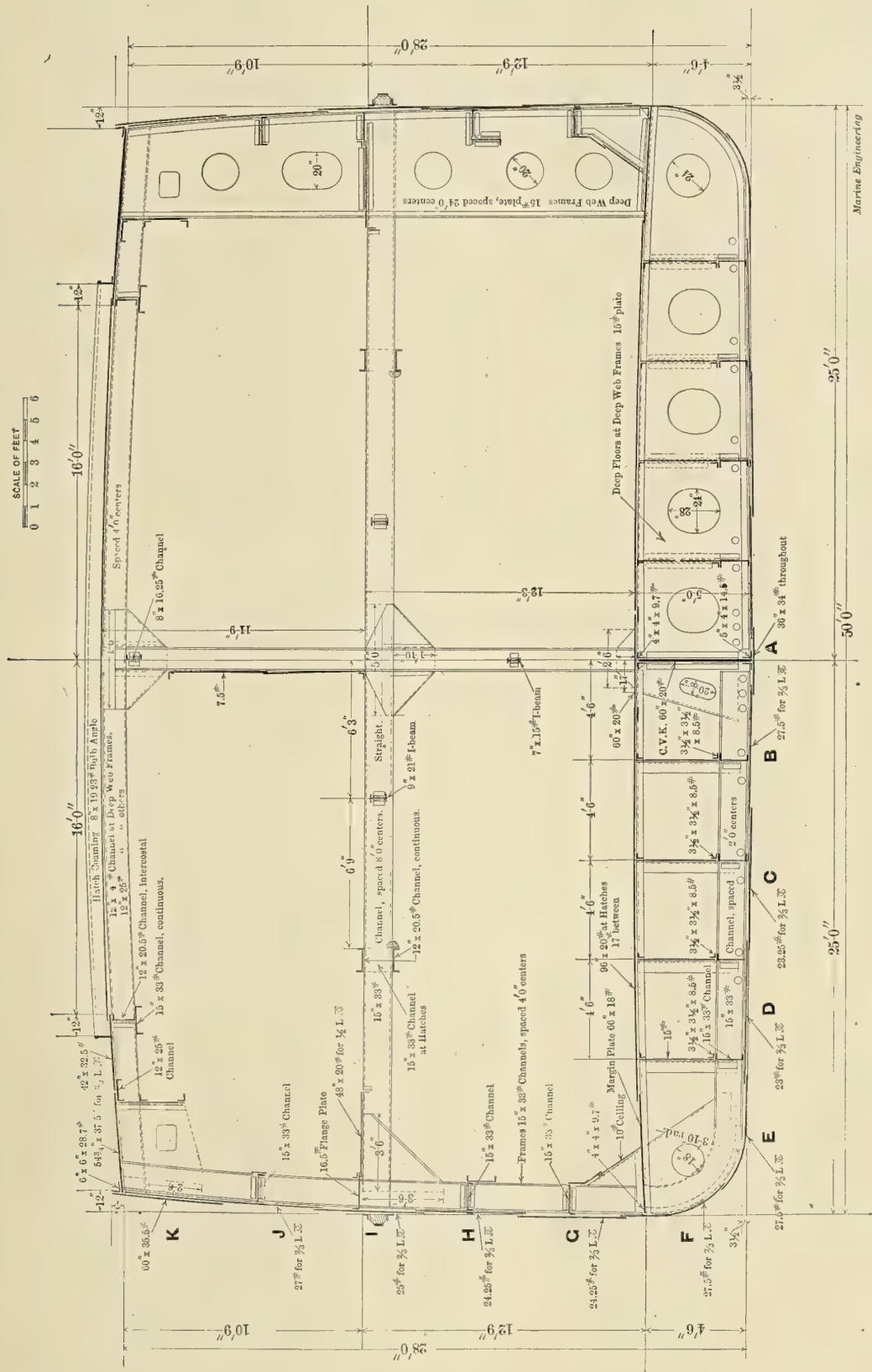
THE CAPTAIN THOMAS WILSON PREVIOUS TO LAUNCHING FROM THE YARD OF THE JENKS SHIPBUILDING CO.

cargoes. The chief dimensions are as follows:—

Length over all.....	440 feet
Length between perpendiculars.....	420 "
Beam, moulded	50 "
Depth, moulded	28 "

The *Wilson* was designed to conform to the highest

well as the hold stringers, stanchions and deck beam ties. In fact, with the exception of a few I-beams at the hatches and bulb angles for the hatch coamings, the only shapes used in the construction were plain angles and channels. As will be noticed from the midship section, the construction is very strong,



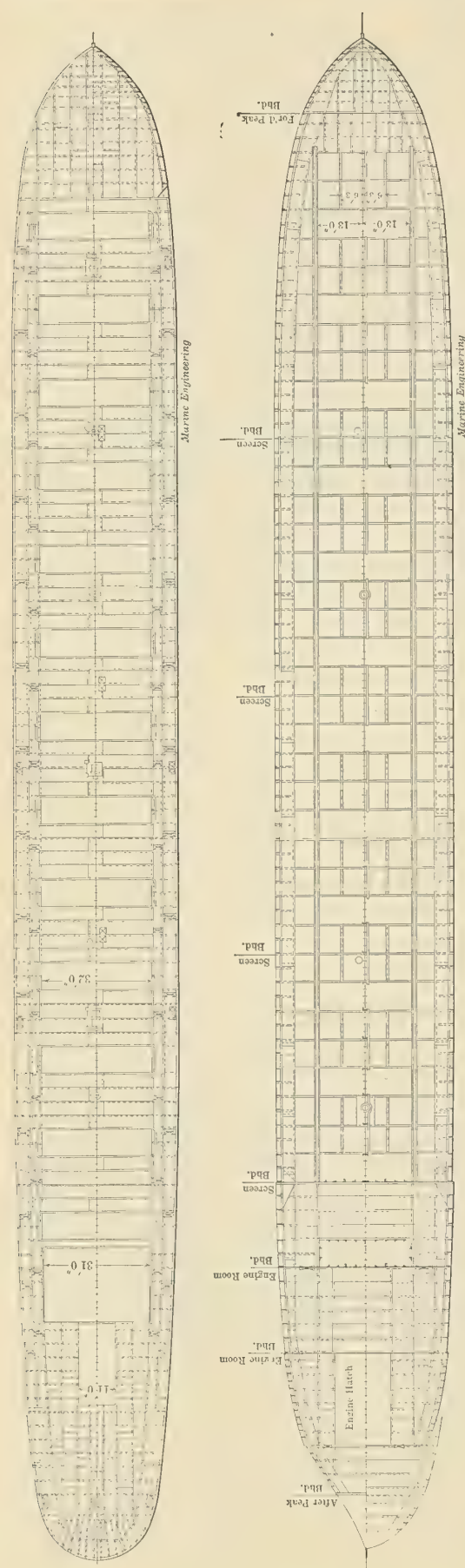
MIDSHIP SECTION OF THE CAPTAIN THOMAS WILSON.

much strength being added to the upper members by a double shear strake and vertical stringer upon the spar deck. As a result of this additional strength

there is an entire absence of weaving so noticeable in other boats of this size when either light or loaded.

In referring to the illustration it will be seen that

the upper deck—so-called spar deck on the lakes—is the only one which is plated. The main deck beams are in place, but no deck laid. In the upper deck



SPAR AND MAIN DECK PLANS OF THE CAPTAIN THOMAS WILSON.

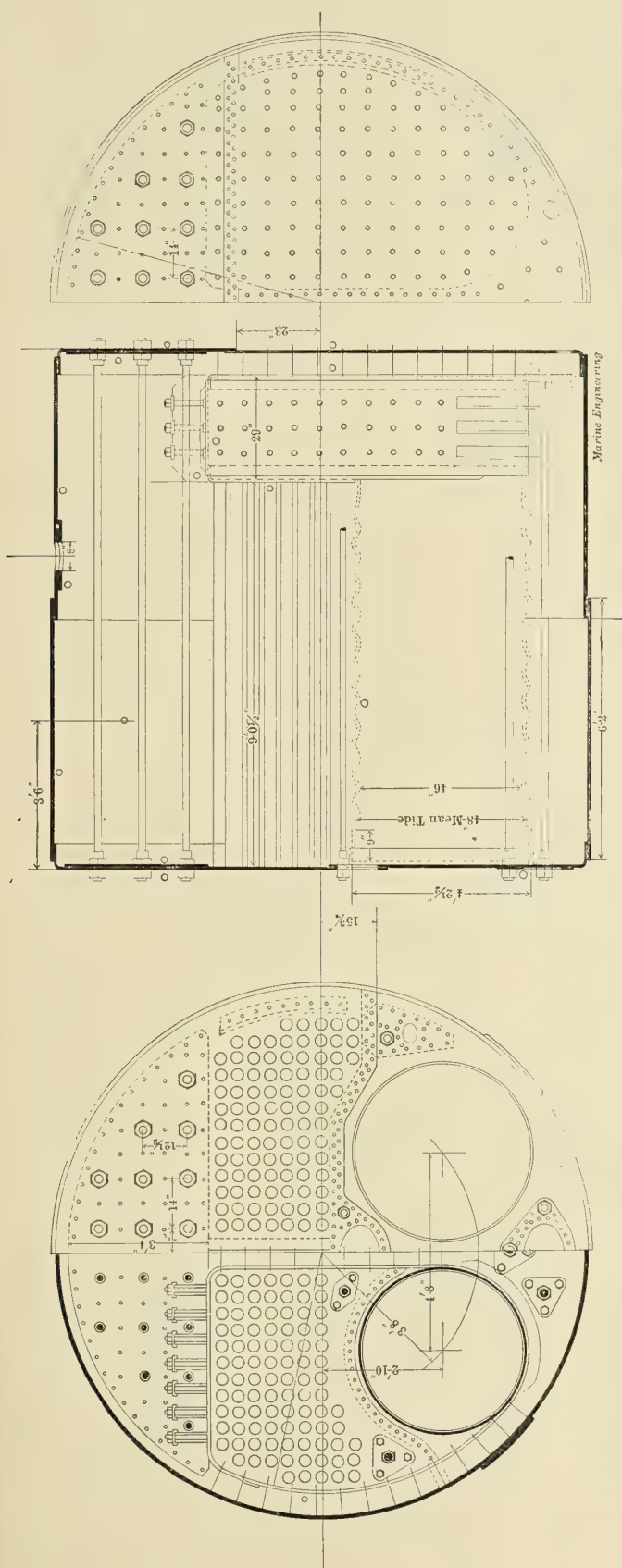
there are thirteen cargo hatches 8 feet by 32 feet, spaced 24 feet centers, and between hatches Nos. 12 and 13 one fuel hatch. The cargo hold extends between the water-tight bulkheads of the engine room and the forepeak, and is divided into four compartments by three bulkheads running from the tank top to the upper deck. Two of these are water-tight, which allows of water being carried above the tank for extra ballast.

Two doors are fitted in each of these two bulkheads to facilitate the unloading of cargo, and are made water-tight by the usual fitting of rubber gaskets, dogs and bolts.

The water bottom is 5 feet deep at the center, and is continuous from the engine room to the forepeak bulkheads. The center vertical keelson divides the water bottom longitudinally, and three solid floors on each side divide the water bottom into eight separate water-tight compartments. There is one ballast pipe in each compartment, by means of which the tank is filled or emptied. This will be referred to later in describing the ballast pumps and piping. There is one 1 1/2-inch sounding pipe in the after end and one 3-inch air pipe in the forward end of each compartment. Both are fitted with air caps, thus providing for a very free movement of air to or from each compartment. The air and sounding pipes are carried through the upper deck, where each is provided with a packing box to make it water-tight.

The *Wilson* is fitted throughout with all the modern appliances for handling ships, consisting of steam windlass and capstan forward, steam capstan aft and two double and one single mooring machines for wire cable on the upper deck. There is also fitted a steam steering gear which operates by steam from the pilot house, and by either steam or hand aft. The ship is lighted throughout by electricity, having one 15 kilowatt direct connected generator, which supplies current at 110 volts to all parts of the ship, including masthead and signal lights. In place of the ordinary speaking tube connecting pilot house with engine room there is fitted a modern telephone arranged with one instrument in the captain's room, and one on top of pilot house connecting with the engine room. The Cory mechanical telegraph is fitted between the pilot house and engine room, and between the pilot house and spar deck aft.

The machinery consists of one vertical, inverted, triple expansion engine, having cylinders 23 inches, 38 inches and 63 inches diameter by 40-inch stroke. The high pressure cylinder is placed forward, the intermediate pressure next and the low pressure aft, the sequence of the cranks being high pressure, intermediate pressure, low pressure. The high pressure and intermediate pressure steam chests are fitted with piston valves, while the low pressure has a double ported slide valve, all being actuated by the double bar Stephenson link motion. The framing consists of three inverted Y columns at the rear, carrying the slides and waterbacks. The three front columns are of box section and carry the reverse shaft. The pistons are of cast steel and conical in section, fitted with cast iron rings. The crossheads are of the single slipper style with brass wearing surfaces for both the



SINGLE ENDED SCOTCH BOILER OF THE CAPTAIN THOMAS WILSON.

ahead and astern sides. The connecting rods have double brasses on the upper end, and cast steel boxes lined with white metal on the lower ends. The main journals, six in number, are lined with white metal. The crank shaft is of hammered iron 12 inches diameter made in two sections, the first section being the high pressure and intermediate pressure, while the low pressure is a section by itself. The crank slabs are of cast steel, the counterbalance being cast on the low pressure slabs. The pins are of open hearth steel. The thrust shaft is 12 inches diameter, having six driving collars. The propeller shaft is also 12 inches in diameter. Each piece of shafting has couplings forged solid on the shaft. There is one cast iron sectional propeller 13 feet 6 inches diameter and 16 feet 6 inches pitch. Steam is supplied by three cylindrical boilers of the Scotch type, 12 feet 6 inches diameter

and 12 feet long, allowed a working pressure of 130 pounds per square inch. Each boiler has two Morrison suspension furnaces 48 inches diameter, and two separate combustion chambers. No forced draught apparatus is fitted. The uptakes are common to all boilers, and are connected with a double smoke-pipe. The top of the pipe is about 50 feet from the fore-grates. The boilers are located fore and aft just forward of the engine room on a deck raised 12 feet above the tank top. The coal bunker is on a level with the boiler deck and extends across the ship between hatches Nos. 12 and 13, and between the skin of the ship and the sides of No. 13 hatch. The fire room is well ventilated with two 30-inch ventilators with revolving hoods. The engine room is ventilated by four 14-inch ventilators with revolving hood.

All the pumps are independent of the main engine;

their sizes are as follows:—

One compound steam and duplex air pump and jet condenser, with cylinders 9 inches and 14 inches, and 19 inches water end by 15 inch stroke.

One compound duplex feed pump, pressure pattern, of the Ott valve style, with outside end packed plungers, having cylinders 8 inches and 12 inches steam end and 6 inch water end by 70 inch stroke.

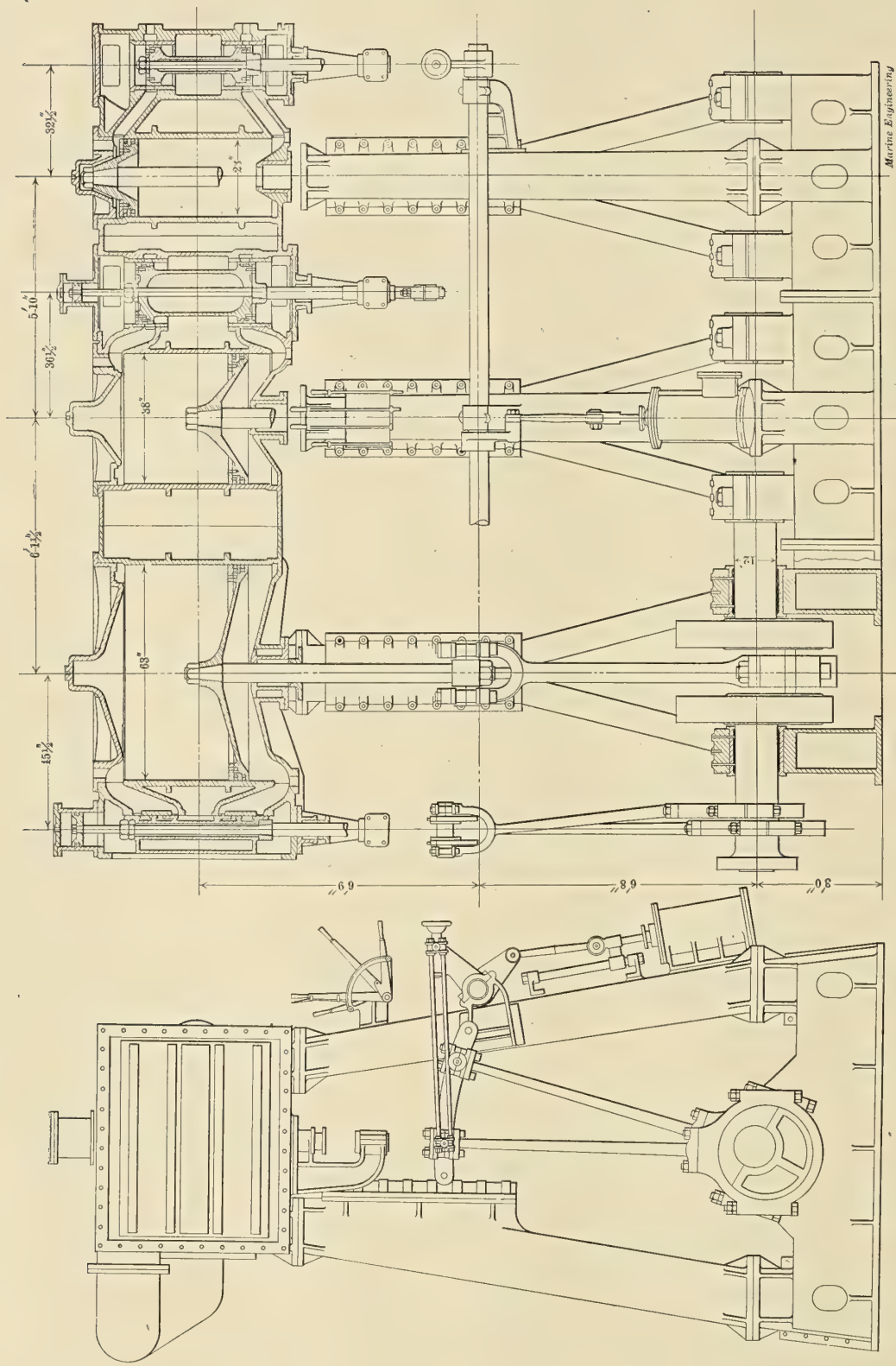
One duplex auxiliary feed pump, having cylinders 10 inches and 4 1-2 inches by 10 inch stroke.

One duplex cooler pump, having cylinders 6 inches and 4 inches by 6 inch stroke.

One duplex bilge pump same size as cooler pump.

Two horizontal duplex ballast pumps having cylinders 12 inches and 16 inches by 18 inch stroke.

One 6 inch by 4 inch by 6 inch duplex deck pump, placed in the forecandle for deck line,

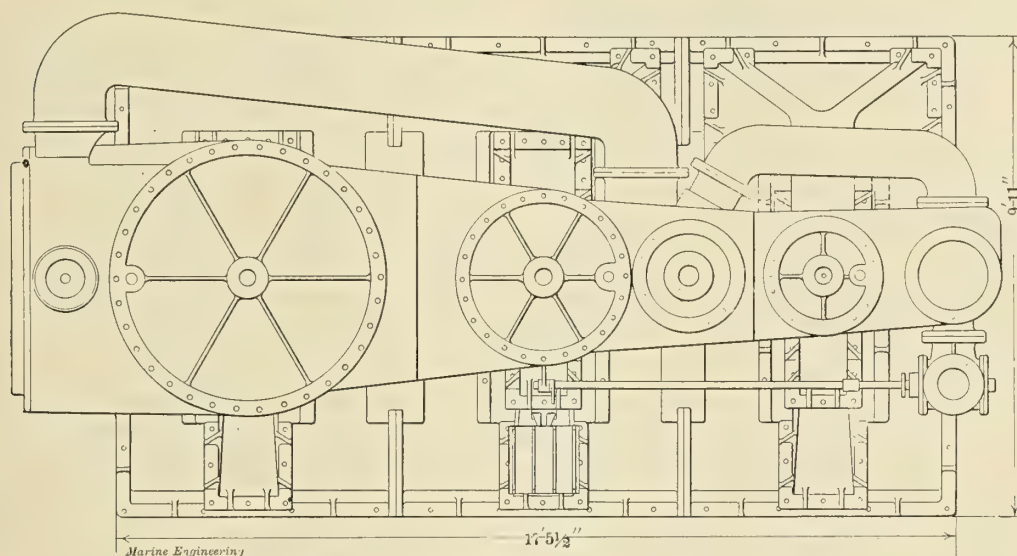


SECTIONAL ELEVATION OF THE MAIN ENGINE ON THE CAPTAIN THOMAS WILSON.

The air pump, feed pump and auxiliary feed pump take steam at boiler pressure, while the others take steam at 80 pounds. The two ballast pumps connect the water bottom through a 12 inch manifold which contains a valve connected to each compartment of the water bottom. There are two 10 inch sea cocks located in the engine room and connected to the manifold for filling the water bottom, the filling being done by gravity. It is thus seen that either of the eight compartments in the water bottom can be filled or emptied separately or all together. The water bottom piping is 7 inches diameter in all compartments except the two after ones, where it is 8 inches diameter. There is also a 7 inch pipe leading from the condenser to the manifold, and thus connecting to the ballast pumps, so that in case the air pump be-

two mates, two wheelmen and two watchmen. On the starboard side beneath and connecting with the Texas is located the owner's suite, consisting of sitting room, sleeping room and bathroom. In the cabins aft on the upper deck are located the dining room and galley, also accommodations for chief engineer, assistant engineer, two oilers, two stewards and four passengers, while the crew's quarters are below the upper deck aft of the engine room.

The *Wilson* carries 6,300 gross tons on a draught of 17 feet 9 inches, and on the first trip her engines indicated 2,100 horse power at full power, revolutions per minute being 88. Her regular speed is 12 miles an hour loaded and 14 miles light, although on one trip she logged 15 miles in 55 minutes.



PLAN OF TOP OF MAIN ENGINE ON THE CAPTAIN THOMAS WILSON.

comes disabled either or both ballast pumps can act as an air pump. The ballast pumps also have a large connection to the engine room bilge, so that when the water is carried above the tank top, on opening the sluice valves on the engine room bulkhead the water runs into the engine room bilge and is pumped out by the ballast pumps. In addition to these the usual number of fire pumps and steam syphons are fitted both forward and aft.

There is also one 2 1-2 inch Metropolitan injector for feeding the boilers in port. The water line for washing decks and for use in case of fire is 2 inches diameter, and runs continuously from the engine room to the forepeak through the water bottom and through the engine room to the spar deck aft of cabins. In the engine room it connects with the auxiliary feed pump, and in the chain locker forward to the deck pump. In the water bottom there are three 1 1-2 inch branches running to the spar deck through the 3 1-2 inch sounding pipes, with valves and hose connections on deck.

The cabins of the *Wilson* are finished throughout in hardwood. Accommodations are provided forward in the Texas for the captain, and in the forecabin for

New Dry Dock.—A new sectional dry dock is being built by the firm of Theodore A. Crane's Sons, Brooklyn, N. Y., for Erie Basin. Each of the five sections measure 60 feet in length, 90 feet in width and 14 feet in depth, and the total lifting capacity will be 4,000 tons.

Coal for the Navy.—In the annual report of Rear-Admiral Bradford, Chief of the Equipment Bureau, United States Navy, he states that \$273,111 was spent during the last fiscal year for 324,108 tons of coal for the vessels of the navy. Thus the average cost per ton was \$7.01. Ten years year the coal consumption was 73,000 tons per annum. Wherever storage could be found, American coal has been placed for our warships; thus 12,000 tons are stored at Yokohama, 5,000 tons at Pichilingue, Mexico, and large quantities in Guam. Bids are about to be opened for a 45,000 ton coaling station at Cavite, P. I., and several small stations have been already located among those islands. With the exception of the coaling station at Porto Rico, none have been established in the West Indies.

Marine Engineering

Published Monthly by

MARINE ENGINEERING,
INCORPORATED

309 Broadway - - - New York.

H. L. ALDRICH, Treasurer and General Manager.

PROF. W. F. DURAND, Advisory Editor.

F. D. HERBERT, Associate Editor.

Branch Offices.

Philadelphia, Pa., Mach'y Dept., The Bourse, S. W. ANNESS.

Detroit, Mich., Hodges Building, L. L. CLINE.

Boston, Mass., 170 Summer St., S. I. CARPENTER.

TERMS OF SUBSCRIPTION.

	Per Year.	Per Copy.
United States, Canada and Mexico.....	\$2.00	20 cents.
Other countries in Postal Union.....	2.50	25 cents

Entered at New York Post Office as second-class matter.

Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

WITH the approaching session of Congress, and with the avowed intention of the President to carry forward the policies outlined by the late President McKinley, renewed interest is becoming awakened in plans for the upbuilding of the mercantile marine. Throughout the entire history of legislation relating to commercial and industrial matters, it is doubtful if there has been any one part of the general subject upon which views have been so diverse as upon the proper policy with regard to our mercantile marine. This has been due to two chief causes, first, a lack of full knowledge of the real facts, and, second, a genuine difference of opinion as to the proper policy to pursue with an admitted basis of fact.

With regard to the first cause, the facts are in existence, but no one knows them with sufficient breadth or completeness to make possible a really intelligent discussion of the problem. The cost of a ship as a whole may be conveniently classified under the following heads: Cost of material, cost of labor, proportion of fixed charges, margin for profit. Now while we know more or less regarding the costs of material, it

is usually in general terms of costs per ton for the various classes employed. There is no one man who has at his command the detailed and specific costs of the material actually employed for building representative ships in the various yards of this country and abroad. Similarly, while we know more or less regarding the costs of labor in terms of daily wages, this is a very different thing from having for specific cases the actual cash payments on the labor account for similar ships built in various yards in this country and abroad. Still less does any one man know regarding these various yards what may be added for fixed charges and for profit. Without such definite and detailed information, how is it possible to make a really valuable and intelligent comparison between the costs of building ships in this country and in Great Britain or Germany? Similar considerations relate to the costs of operating ships. While we know in a general way rates of wages and shipping supplies, and that it costs more to operate an American than a foreign ship, yet we are not in possession of the details; or at least such details for large numbers of representative cases are not in the possession of any one person or of the public at large. It is this lack of knowledge of definite and specific details which makes a discussion of remedial measures so difficult and almost useless. It is true that occasionally we obtain isolated specific facts as, for example, those lately furnished from the office of the Commissioner of Navigation relating to the comparative costs of similar ships in the United States and Great Britain. These facts are found in a letter from the President of the Atlantic Transport Company, and show that in one case for the construction of a mercantile steamer of large size the cost in the American yard was about 30 per cent. in excess of that in the foreign yard, while in the case of two smaller ships the similar excess was nearly 50 per cent. It should be pointed out, however, that the foreign-built ships, upon which the basis for comparison is made, were built some eighteen months or more ago, when material was considerably lower than it is at present. The rise in material since that time should undoubtedly be taken as giving an explanation of part of the excess in price quoted, but it is by no means sufficient to account for it all. Substantial differences in favor of the British builder remain as specific and definite facts. Their complete and adequate

explanation, however, is still a matter of conjecture. The recent rise in the cost of materials accounts for a part, the difference in the wage rate accounts for something more; but against the latter should be offset the advantages which we probably have in increased facilities for handling material and in the greater use of machinery instead of hand labor. Again, differences in costs of administration and in fixed charges in general may help to account for a part, while it is quite sure that the American yard wishes to make a larger margin of profit than would perhaps satisfy the British investor. In fact, if a shipyard project is to meet with favorable consideration from the American investor it must be ready to show a fair probability for profits as large as those which he may expect in other large enterprises which are likewise before him for consideration. Are all of these causes combined, however, adequate to account for differences of from 30 to 50 per cent, and if so, in what proportionate share, and are they wholly inherent or partially removable, and if so, to what extent and by what means? These are questions which need full study in connection with this general question, and until such a full array of facts is available as shall make possible such study in an intelligent manner we shall be only wandering in the dark. Like considerations hold with regard to operating ships, and with regard to the subject of foreign commerce in general. The ultimate facts as they at present exist are admitted, but the facts which would make possible an accurate and exhaustive estimate of the causes and an intelligent application of remedial measures are unknown in their detail, and so long as such is the case we shall make but sorry work in attempting to legislate with a view to the improvement of the existing conditions of affairs. That the American mercantile marine should and must be rebuilt is an admitted duty. It is equally necessary to admit the existence of honest differences of opinion in regard to the best way of accomplishing this end. The subject is one deserving the most careful and earnest study on the part of Congress, and it is to be hoped, if the lack of definite information shall be found a bar to the intelligent study of the situation, that Congress may find a way to acquaint itself with the facts, and in such measure as shall make possible an equitable and permanent solution of this problem, at present of so great importance to the American people.

ATTENTION may be called to the report of the ninth annual meeting of the Society of Naval Architects and Marine Engineers, which will be found elsewhere in the present issue. The meeting was entirely successful from the standpoint of the number of members present, the general quality of the papers presented and the interest manifested in the society and its work. The chief difficulty, and one of long standing, was in the lateness of the date at which the papers could be printed and distributed to the members. It is always difficult to discuss papers intelligently and usefully on short notice, and especially when the first acquaintance with them is made by hearing them read from the desk. In order that the discussion may be really enlightening, the papers should be in the hands of the members for some days before the meeting. That this is impossible seems largely, or, perhaps, entirely due to the lateness of the date at which the papers are sent in to the secretary. Unavailing efforts have been made from year to year to get in the papers at an earlier date, so that they could be printed and distributed a week or ten days before the date of the meeting. It seems almost impossible to accomplish this end, and probably will be as long as it is understood that papers will be accepted up to the latest date necessary to make possible their printing for the meeting itself. Much might be done if a keener appreciation of this subject could be brought home to the consideration of those who are intending to contribute. In some cases it may be that unforeseen circumstances will arise necessitating delay, but in the large majority of cases the paper could be as well completed a month earlier as later. It simply is not completed a month earlier because there is no absolute necessity, and so, yielding to the natural inclination, its completion is delayed until perhaps repeated reminders from the secretary bring the manuscript and drawings in at the eleventh hour. It results that the papers cannot be printed in time for distribution, and even the program itself is in doubt until a few days before the date set for the meeting.

Such a condition of affairs does not exist of necessity, and we would earnestly appeal to the contributing membership of the society to hold up the hands of the secretary in this matter and make possible the distribution of papers in time to give opportunity for study in advance of the meeting itself.

THE CONTEST FOR THE PRIZES.

All articles intended for competition for the two prizes of \$15 and \$10 each, mentioned in our advertising pages, must be sent in promptly, as the contest will close on December 31.

All articles published will be paid for at the regular rates. The best and the next best will draw the prizes in addition.

Repairs to the Engine of a Lake Steamer.

I have been in the Lake service for thirteen seasons, and have had four mishaps to a pair of simple engines running condensing with cylinders 36 inches by 32 inches, both engines being mounted on one shaft.

The first accident was the splitting of the forward piston head, which rendered that cylinder worthless. I pulled out the rod and the piston, centered the valve of that engine, and finished the run from Lake Michigan to Buffalo, about 500 miles, with the other engine, experiencing no trouble and making nearly the ordinary time. This repair took 2 hours and 35 minutes. Three seasons later the key in the bottom end of the piston rod cut through the keyway, leaving the key in the crosshead. I made the same repairs as in the first breakdown, finishing the trip from Lake Superior to Cleveland without further trouble. In both these accidents I was on watch, and happened to be near enough to shut off the steam in time to save further damage, and in neither case was there a mark inside the cylinder to tell that anything had happened. The third breakdown was in the crank. This was a solid forging with the webs, and the break occurred at the forward end of the after crank. The excentrics were between the two cranks, the valves for both cylinders being in the same steam chest. The forward engine made one turn ahead of the after one and brought up solid on a small lump. Under reduced steam pressure we made Buffalo, about 100 miles distant, and there a temporary repair was made which carried us through the season. A 5 inch hole was bored through the crank pin and webs, and a soft steel pin was driven through this hole and headed down at either end. The crank pins were 9 by 9 inches.

The engine was then rebuilt and made into a four cylinder triple expansion, two crank engine, with high pressure cylinder built on top of the forward cylinder, and the intermediate cylinder built on top of the after cylinder. Thus there were two steple engines with cylinders 18, 28, and 36 inch diameter by 32 inch stroke. On one trip the high pressure valve stem became bent, and I pulled out the valve and finished the trip with three cylinders, making a compound, which worked very well.

So, in the thirteen years I have run this boat with one, two, three and four cylinders, which I think is quite a feat.

The last season which the old engine was run we made 24,000 miles and burned \$7,800 worth of fuel, and the next season with the four cylinder triple we ran 36,000 miles and burned \$7,300 worth of fuel. Both seasons the boat was in the same trade and on the same route.

A. A.

Replacing Leaky Rivets.

With the modern pneumatic equipment of shipyards, and the increased skill of hand riveting, the engineer of today seldom has occasion to resort to fishing of rivets as some of the old timers have had to do in the early days of iron ships. In many of the older class of vessels the riveting below water line was extremely bad, so that at every lurch or strain of the vessel fine streams of water came through the badly filled rivet holes. Besides causing extra work for the pumps, these leaks made it very uncomfortable for those working in the locality.

One of the means for remedying these leaky rivets while in port, was to cut off the rivet heads, having a bolt ready with easy fitting nut, grummet and washer, to drive the rivet out and to place the bolt in position in the following manner:

A good sized cork, which could be shoved through the rivet hole, was procured, and enough twine to reach from the inside of the ship to the water line was fastened to it. The cork was pushed through the rivet hole and the twine paid out until it reached the surface. The man above, who was watching for it, then tied the bolt on to the string and lowered it while those inside hauled in the twine, and, when the bolt was nearby, with a little guidance they pulled it into the hole with a piece of wire, and then the washer, grummet and nut were put on and screwed hard up. The bolt should be an inch or so longer than usual and the thread cut deep, so the nut would not bind until it was tight against the plating, and then it could be screwed up while the bolt was held from turning.

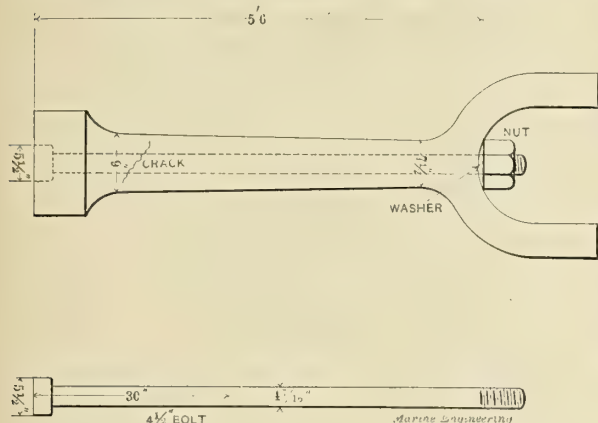
Though the modern engineer has many added responsibilities, due to the complication of machinery, yet the breakdowns and repairs in former days resulting from poor workmanship have almost disappeared in good practice.

A. P. A.

Repairing a Cracked Connecting Rod.

We had just arrived at Dutch Harbor, Alaska, when the first assistant engineer reported a serious crack in the L. P. connecting rod of our main engine just above the crank pin connection as shown in the accompanying sketch. Whether to try and strengthen the rod or disconnect the L. P. engine and return to Seattle, a distance of some sixteen hundred and fifty miles with the H. P. and M. P. engines was a question for me to decide. As we had only commenced our cruise, I disliked to return, and after looking everything over carefully, I decided the rod could be strengthened sufficiently to do our work for the season with perfect safety. The connecting rod was 5 feet 6 inches from the bottom of the fork end to the stub end, and 7 1-2 inches and 9 inches diameter respectively, with a uniform hole of 4 1-2 inches diameter extending the entire length. The rod was taken down and placed on the bed of our lathe and the hole in it countersunk at the stub end to the depth of 2 inches by 5 1-2 inches diameter. One of our boat davits was taken into the fire room and a piece cut from it long enough to make a bolt which would extend the entire

length of the hole in the rod and allow for a nut on the end. One end of the piece was upset to form a head and then turned exactly the same size as the hole in the connecting rod for a distance of 30 inches with the head turned to fit the countersink in the rod. A thread was cut on the other end to fit a nut from one of the spare crank pin connection bolts, while a washer was made to fit the circle of the fork end. When everything was ready the rod was heated very evenly over a charcoal fire so as not to twist it and



METHOD OF REPAIRING A CRACKED CONNECTING ROD.

the long bolt made from the davit was driven into the hole in the rod and the nut set up and the rod allowed to cool, after which a small hole was drilled at each end of the crack to prevent it spreading. The rod was then connected to the crosshead and swung to test its alignment, which was found to be satisfactory, and we finished our cruise of about ten thousand miles without further trouble.

WILLIAM DUNSEATH.

Anthony Pollock Prize.—The second competition for the Anthony Pollock Prize of \$20,000 for the invention of the best means of preventing collisions at sea, preserving vessels in case of collision and saving the lives of those on board, was recently closed in Havre, France, without the prize being awarded. Many designs and models were presented, but the judges decided that none were worthy of the prize.

Marconi Wireless Telegraphy Improvements.—Improvements in the Marconi system of wireless telegraphy have been made by Mr. F. J. Cross, of the Wireless Telegraphy Company, according to the *Electric Review*. He has devised means for transmitting the impulses of the Marconi system to regular telegraph wires. He has also invented a new coherer, whereby the filings in the coherer are not worn away, as is the case in the Marconi system, where a light hammer is used to tap the glass case. Several tubes filled with filings are placed with axes parallel in a large cylinder, which revolves when messages are being sent and received, and only that tube, which at the moment is at the top of the cylinder, transfers the messages, and as it revolves the weight of the filings tends to separate them.

These improvements are now in operation on one of the Honolulu telegraph lines.

Coaling a United States Transport on Foreign Service.

Editor of MARINE ENGINEERING:

It may interest your readers to know how a United States government army transport is coaled while carrying troops to and from the Philippines. We left the United States in 1899, after having coaled at San Francisco. The next point of coaling was at Honolulu.



COALING AT NAGASAKI.

On the return trip we coaled both at Honolulu and at Nagasaki. The time consumed to coal at each station was about four days. The most interesting sight was at Nagasaki, where about four hundred little Japs, nearly one-half women, coaled up with rapidity, without mechanical devices.

This picture shows the coal barges run up along side of the transport. There were many of these barges, and for one day and night at least, it was an almost impossibility for any other craft to approach us, because the Japs had so many of their boats secured to our sides. Every opening in the side of the transport



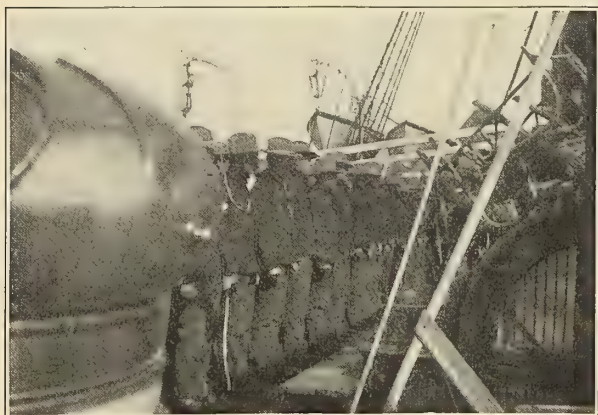
JAPANESE WOMEN PASSING COAL.

was used to receive coal, while lines of women were formed on ladders and along the decks to pass coal in baskets from one to another.

This view shows the strong, red-cheeked, little, bright-eyed Japanese women passing coal from the line formed from the coal boat, up a ladder over the side to the deck. These women work with great speed, and

they maintain the speed for hours, laughing and chattering in the meanwhile.

At all other places where we coaled, they employed mechanical devices of some sort, but we were never coaled so quickly as at Nagasaki. A Japanese contractor comes off as soon as a transport or steamer arrives, and with his force of helpers quickly measures the bunker space to fill. He then contracts for the



ROLL CALL AFTER COALING TO LEARN WHO ARE MISSING.

coal, and in less than three hours has about four hundred Japanese men and women loading coal from a dozen boats into the hold of the vessel. After coaling at each station, we had roll call to find out who were missing. At Nagasaki twelve soldiers were missing after coaling, as they probably went ashore on the returning boats. A squad rounded up ten of these



A PARTING SALUTE.

men in the city in a few hours, and the others were never found, or at least they were not found in time to join us.

Our band always played a parting salute to the hard-worked coal passers upon leaving, and in return we received the cheers of the appreciative workers. "Ex-VOLUNTEER."

Steam Turbines.—A German company has been formed to construct ships equipped with Parsons steam turbines.

THE PROFESSOR ON SHIPBOARD.

Story of an Attempt to Combine Theory With Practice.

BY C. A. MCALLISTER, FIRST ASSISTANT ENGINEER, R.C.S.

CHAPTER IV.

Although the Professor was tired out from his exertions below during the mid watch, he was unable to sleep after he got in his berth. It was simply a case of "hang on" for the rest of the night. He managed by considerable ingenuity to arrange a sort of bulkhead out of the pillows and a blanket, which prevented his being rolled out on the floor. Finally overcome by fatigue he fell into a series of cat naps, broken at intervals by sudden awakenings due to unusually heavy seas striking the vessel. When daylight came he did not feel like arising, so he occupied his bunk the entire morning. Just before noon, finding it impossible to gain any rest or sleep in bed, he got up and dressed with great difficulty. The thought then occurred to him whether his companions below who had worked the entire mid watch, felt any better than he did, and if they did not, how it would be possible for them to put in another watch. He went into the main saloon and sat down to the table; as he felt considerably nauseated his order for the meal was very small. By bracing himself and holding on with one hand he managed to eat a few crackers and take a plate of soup, which he hoped would stay down long enough to give him a little nourishment, as he was badly in need of it. After this was over he made his way out on deck where he was almost appalled by the enormous size of the waves which beset the ship. It looked to him as if each one in succession would surely engulf the vessel. Finding that such occupation only added to his fears, he concluded to again go into the engine room. As he entered, the hot air and smell of burning oil nearly drove him back, and he was for a few moments in a quandary as to whether he would retain his light luncheon or not. Finally, by vigorous use of a lemon which one of the waiters had given him, he managed to dispel his approaching nausea, and by considerable mental and physical effort made his way to the lower engine room. Here he found the assistant engineer standing at the throttle with the same rank smelling old pipe in his mouth, but he was too busy even to look around, as the diving of the ship into the head sea caused the engine to race violently at frequent intervals. As she would run up on an approaching sea, the engine would almost come to a standstill, to be followed almost instantly by a tremendous spurt, wherein it seemed to the startled college man that it was making about five hundred revolutions a minute. By the prompt shutting down of the throttle this running away tendency would be checked before any damage could be done. This brought the subject of marine governors vividly to his mind, and although he racked his memory he could not think of ever having heard or even read of a governor that worked successfully on a marine engine. Here, thought he, is a fine field for inventive genius, although he could now readily understand that the problem was not an easy one. Any mechanical device, he reasoned, would fail on account of acting too slowly,

so he mentally concluded that the best field of experiment would be with electrical devices, wherein an electro-magnet could be arranged to act on the throttle lever. He further determined that at the first opportunity, he would try to get up some scheme to accomplish this purpose, and thus save marine engineers from one of their most disagreeable duties when a vessel is pitching into a head sea. Although the Professor did not realize it, he was arranging a job for himself that countless bright men have been unable to solve.

As the Professor intended to devote his attention from this time on, principally to the engine room, he at once proceeded to make the acquaintance of the oiler on watch, whom he readily understood was a very important man to know. The oiler on this watch was a large, good natured Irishman by the name of Bernard O'Connor, known to his associates as plain "Barney."

In the intervals between Barney's regular rounds of oiling, for he had his work very well systematized, he would come up to the place where the Professor was sitting, and in a short time had grown very confidential with him, telling him as the popular expression goes "the story of his life." The college man was a good listener, and knew from experience that this was the best way to get at the oiler's views on different subjects. In the course of the snatches of conversation during the early part of the watch, he learned that Barney was one of that old school of engine drivers now unfortunately dying out, or at least not being replaced by men of similar ability. He had begun life on a large transatlantic steamer as a coal passer, where, after securing many hard knocks, he had worked up to be one of the best firemen on the line. Indeed, stories are told to this day of Barney's wonderful prowess with shovel and slice bar. "Ah!" said Barney, "I can knock the stuffing out of this whole gang in the fireroom now, even though I am on the shady side of forty." After firing for a number of years, he was put into the engine room as an oiler. He had knocked around from vessel to vessel, until there were but few ports in the civilized world that he had not visited. Having the natural wit of his race, he regaled the Professor with numerous amusing incidents of his experience. So pleasantly had the time passed that the Professor had almost forgotten the discomforts of holding on and keeping from sea sickness. Now, having installed himself in Barney's good graces, he suggested that he be allowed to accompany him on his rounds.

"To be sure you can, Professor," said Barney. "Come on with me!" Being in the lower engine room, they first went to the H. P. eccentrics, which Barney slapped with the flat of his hand on each side, and remarked: "Cool as a cucumber, Sor;" he then squirted some oil in the oil cups, more of course in the go-ahead eccentric than in the other one. The Professor reached out his hand in imitation of the oiler, and made an attempt to feel of the side of the go-ahead eccentric strap; as he did this very slowly, his hand missed the H. P. strap, and he felt of the backing strap instead, at the same time narrowly escaping having his hand caught between the two straps. This caused Barney to ejaculate, "Niver touched it, Pro-

fessor!" He then explained to the book man that he must give his right hand almost the same motion as the eccentric, but to always keep just a little behind it. After several attempts, the Professor caught the motion and succeeded in feeling both straps. He said, "So you call those straps cool, do you? Why, I think they are quite warm." "Ah, Sor!" rejoined Barney, "that's where you're mistaken; they are plenty cool enough." The Professor concluded that feeling bearings, etc., must be largely a matter of judgment, based on comparisons. Barney next lifted out a tallow box, put his hand in and felt of one of the main bearings, nodding his head to indicate that that was in a satisfactory condition.

The Professor followed his example and found that feeling main bearings was a comparatively easy matter, but he wondered what purpose the cup full of tallow served. Asking his companion, he was told that it was supposed that the tallow would melt and lubricate the bearing in the event of its becoming overheated. Barney said, "That's what it is supposed to do, but the box don't go within a half an inch of the journal, and by the time the journal gets hot enough to melt that grease, it's a hose you'd be needing instead of ile." This struck the Professor as being rather logical, and he made a mental note of that matter. Barney then proceeded in a very easy manner to feel of the crank pin brasses on each side, at the top and at the bottom. This also seemed to please him, for he proceeded to squirt some oil in the cup on the side of the rod. The Professor made a motion as if to feel the crank pin, but was interrupted by Barney, who said, "Hold on there, Professor, this ain't no cinch; wait until I show you how it is done." He then carefully instructed his newly found friend to move his hand in a motion so that it would follow just under the crank pin, and to be sure that the movements of his hand kept exact time with the revolutions. The Professor made motions outside until he thought he had them down fine, when he quite confidentially stuck his hand near the crank pin and gradually worked it in towards the brasses, keeping time with the revolutions. At first the tips of his fingers just touched the projections on the brasses, and he grew a little bolder. The first thing he knew he had lost the motion, and with an expression of pain he withdrew his hand, but not until the thumb nail had come into violent contact with the top edge of the brass. That the nail had not been torn off was very fortunate, but the end of his thumb was sufficiently bruised to keep the Professor from feeling any more crank pins, unless the engine was stopped. Thus they went along the engine, and Barney felt of each eccentric, crank pin and main journal in turn, finding them cool and administering more or less oil to each as they required. They then went to the thrust bearings, and at Barney's invitation the Professor stuck his hand in to feel of one of the rings, only to draw it out much more quickly, as he thought his finger was burned. "Surely you call that hot, don't you, Barney?" "Oh, no, Sor!" said he, "wait until she smokes, and then its time to get worried over thrust bearings." The Professor noticed, however, that there were several small streams of water running on the outside of the bearing, and that the tallow which the

oiler put in between each ring melted almost as quickly as it was put in. They then walked down the shaft alley, where the three spring bearings were found to be running cool. The stern tube gland having a small stream of water playing on it was also found to be cool, so they retraced their steps and went up on the platform. Here Barney began by squirting a little oil on the H. P. valve stem guide, then in turn gave all the little journals about the links a squirt or two, felt of the crosshead brasses, and gave them a little oil; then felt of the guides and oiled them. In this way he attended to the intermediate connections, and finally the low pressure connections, the Professor following along and watched him closely. He next drew a quart of cylinder oil and filled up the sight feed lubricator on the high pressure steam connection. Then he got up on top of the cylinder heads and put some cylinder oil in each cylinder and valve chest. Going down on the grating again, he got an old tin bucket which was half filled with cylinder oil, and with an improvised swab began daubing cylinder oil on each of the valve stems and piston rods. "Now, Sir!" said he, "I am through for a few minutes, until the old ticker over there points to another half hour. The Professor now had a fair idea of the system of lubrication in vogue, and as he had made a study of several different systems, he decided to make some suggestions with a view to ascertaining Barney's practical ideas on the subject. He was becoming convinced by this time that he had much to learn from such men as this oiler, who had spent his life at the business, and he also felt satisfied that he might, from his wider range of vision, give them a great many ideas which would be to their advantage. Accordingly he opened up by saying, "Barney, is it necessary for you to use so much oil in the cylinders?" To this the oiler answered, "Well, I don't exactly know that it is, Sor, but I always have used considerable of it, and I suppose everybody else does." The Professor then told him that there were a number of torpedo boat engines in the navy, the cylinders of which had never had a drop of oil put in them, and that they ran along without any difficulty. The whole fact of it is, he continued, entirely too much cylinder oil is used in marine engines. The result is that it, of course, passes out with the steam, gets into the condenser, where it reduces its efficiency by becoming smeared over the surface of the tubes. In spite of the fact that effort is made to filter it out in the feed tank, more or less of it is bound to remain mixed in with the feed water, with which it finally enters the boiler. The result is that it practically ruins tubulous boilers; in Scotch boilers, if they are not given frequent cleanings, the furnaces are liable to drop. It coats the tubes of Scotch boilers, and as it is absolutely impossible to clean these, except the outside rows, the efficiency of the boiler is greatly decreased. The consumption of fuel may be practically the same, but the steam generated will never be so great as when the boilers are brand new, all due to the use of large quantities of this cylinder oil. "Phew!" said Barney. "Shure I had no idea that cylinder oil would raise such a divil of a fuss as all that." "Indeed it does, my man, and even worse than I have told you. Now, Barney, I want you to try and see if you can't

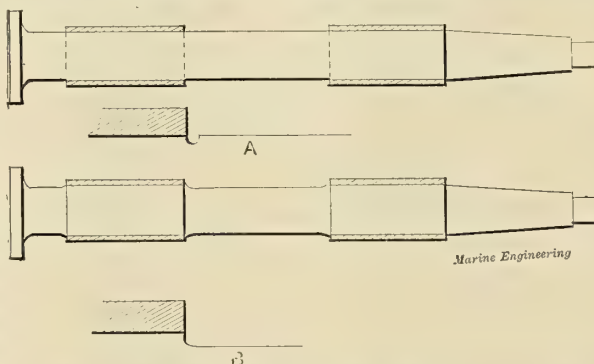
use just half the quantity of cylinder oil during your next watch. I will come down here with you, and we will observe things together, and talk over lubrication matters still further." He handed Barney a few cigars, which he had laid in for such occasions, and went out on deck, where he found that the gale had subsided considerably, but that the sea was still running pretty high.

Propeller Shafts.

Editor of MARINE ENGINEERING:

Dear Sir: I have been very much pleased and interested to see that you have taken up for full investigation and discussion the subject of "Causes of Breakage of Propeller Shafts," and I trust that the intelligent way in which you have treated the matter will lead marine engineers who have had experience in this direction to give you what knowledge they want on the subject.

So far there seems to have been no method devised to overcome the very serious cause of breakage, which comes under the head of corrosion due to the contact of the two metals, brass and steel, or iron, when in the presence of salt water. A battery seems to be formed



at once which eats out the metal forming the positive pole of the battery just where the two metals are in contact in the presence of the salt water, namely, at the end of the brass liner. This causes a nick in the metal, running around the shaft, which reduces the sectional area at this point to such an extent as to concentrate the stresses sufficiently to cause the shaft to fail. Many suggestions have been made in the direction of ameliorating the trouble, and one of these, which, I think, is a simple one, I give herewith for your records. The ordinary tail shaft is designed in accordance with sketch *A*. This shaft is of the same diameter throughout its length. The corrosion will of course occur at the end of the liners, as shown in the detailed sketch. By making the design in accordance with sketch *B*, you will see that at the point where the brass liners and the shaft are in contact in the presence of the water no harm can be done for a considerable period, as the result of the corrosion of the steel or iron shaft, as the diameter at this point is increased. Experience has shown that in shafts made in this manner the corrosion does not nick into the shaft below the line of the smaller diameter; but acts upon the surface directly below the ends of the liners, as in the enlarged sketch of *B*. Yours truly,

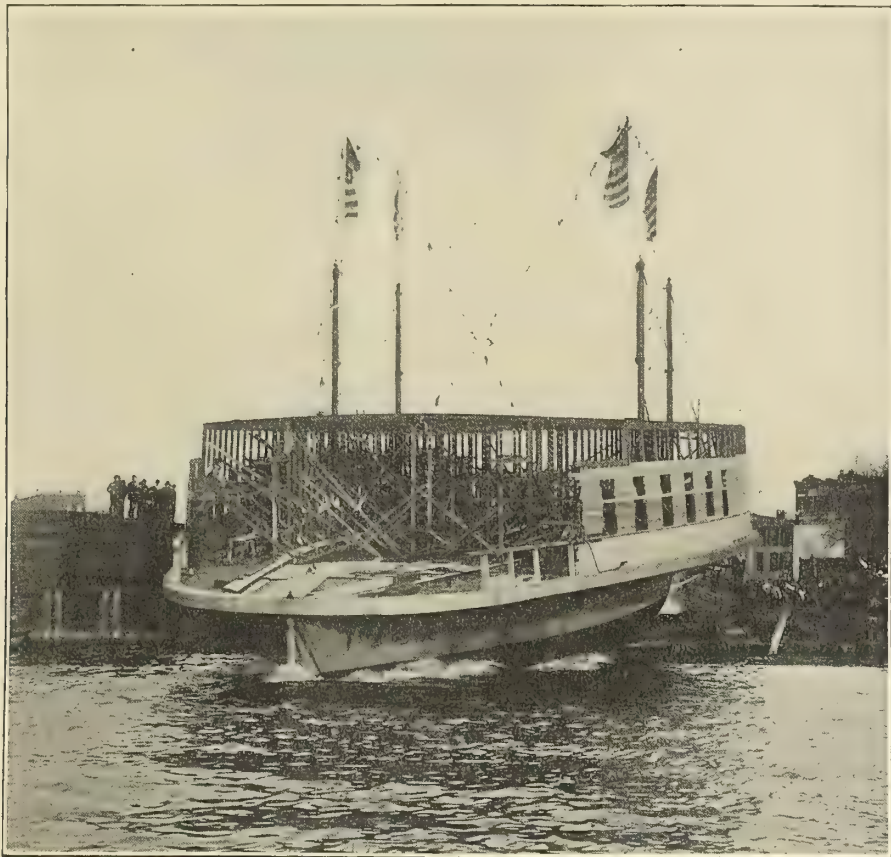
H. F. J. PORTER.

LAUNCHES.

Ferryboat Port Morris.

The *Port Morris*, belonging to the College Point Ferryboat Company, was successfully launched from the Burtis Shipyard, Brooklyn, on October 23d. She was designed by Mr. H. J. Gielow, of New York, and is of the following dimensions: Length over all, 150 feet; beam over guards, 60 feet. She will have

Steamship Siberia.—On October 19th the Pacific Mail Steamship Company's steamship *Siberia* was launched from the yard of the Newport News Shipbuilding and Dry Dock Company. The dimensions of this new ship are: Length between perpendiculars, 550 feet; length over all, 572 feet 4 inches; beam, 63 feet; depth, 40 feet; draft, 27 feet; displacement, 18,600 tons. Twin screws, four cylinder quadruple expansion engines, indicating collectively about 18,000 horse-power, drive the ship at the speed of 18 knots.



LAUNCH OF THE FERRYBOAT PORT MORRIS.

accommodations on two decks for passengers, and will be fitted with all modern improvements, including complete electric lighting plant and a Williamson Bros.' steam steering gear. The engine and boilers are built by Theodore Smith and Sons' Company, of Jersey City, who received the contract for the entire work and sublet the hull to the shipyard company. The beam engine has a cylinder 40 inches in diameter by 8 feet stroke, and steel gallow's frame. The boiler will be of the leg flue and return tubular type, fitted with a super-heater and corrugated linings.

Steamboat Springfield.—On October 14th the steel steamboat *Springfield* was launched from the shipyard of the Pusey and Jones Co., Wilmington, Del. The dimensions of this vessel are: Length, 135 feet; beam, 28 feet; depth of hold, 9 feet. She is built for the Bordentown and Philadelphia Transportation Company.

Steamer Brandon.—The single screw freight and passenger steamer *Brandon*, built for the Old Dominion Steamship Company, was launched from the yard of the Harlan and Hollingsworth Company, Wilmington, Del., on November 16. She is of the following dimensions: Length over all, 213 feet; length between perpendiculars, 205 feet 2 1-2 inches; beam, molded, 37 feet; width over guards, 43 feet; depth, molded, 17 feet 3 inches. Her motive power consists of a triple expansion engine with three cylinders, 18, 28 and 45 inches in diameter, by 30 inches stroke, supplied with steam, at a working pressure of 170 pounds per square inch, from two Scotch boilers 12 feet 9 inches in diameter by 10 feet 6 inches. The *Brandon* is the ninth vessel launched by this company during the present year. She is built to class with the American Bureau of Shipping and the United States Standard for coastwise service.

Submarine Boat Shark.—The submarine boat *Shark*, one of the five submarine torpedo boats built for the United States Navy by the Crescent Shipyard, Elizabethport, N. J., was launched on October 19th.

Caisson for Dry Dock.—A steel caisson has been recently built and launched at the Charleston Navy Yard, and will be used in the old dry dock at that yard. The caisson is of steel and weighs about 400 tons.

Barge Trevorton.—The coal barge *Trevorton* was launched at Noank, Conn., by Robert Palmer and Sons on October 19th. This barge will carry 3,000 tons of coal, and is built to the order of the Philadelphia and Reading Coal and Iron Company.

Henry Steinbrenner.—The steamer *Henry Steinbrenner*, a sister ship to the *Captain Thomas Wilson*, described in this number, was launched by the Jenks Shipbuilding Company, at Port Huron, Mich., on September 28. Her dimensions are: Length, 440 feet; beam, 50 feet; depth, 26 feet.

Revenue Cutter Tuscarora.—The revenue cutter *Tuscarora*, known officially as No. 7, and built for service on the great lakes, was launched from the yards of the William R. Trigg Company, Richmond, Va., on October 29th. The length over all is 178 feet, molded beam 30 feet, and the depth at side is 15 feet. Triple expansion engines of 1,200 estimated horse power are designed to give the vessel a speed of 14 knots.

Torpedo Boat Chauncey.—On October 26th the United States torpedo-boat destroyer *Chauncey* was launched at the yard of the Neafie and Levy Ship and Engine Building Company, Philadelphia, Pa. She is the second of three being built by this company for the United States Government, the *Bainbridge* having been launched some time ago, while the *Barry* is still on the stocks. The *Chauncey* was launched, as was the *Bainbridge*, with engines and boilers in place, and with most of the permanent equipment on board. The dimensions of these three vessels are the same—245 feet long and 23 feet beam. The guaranteed speed is 29 knots.

Steamship El Alba.—The Morgan Line steamship *El Alba* was launched from the yard of the Newport News Shipbuilding and Dry Dock Company on November 2d, making the fourth belonging to this line to be launched from the yard this year. The dimensions of the *El Alba* are: Length over all, 408 feet; length between perpendiculars, 380 feet 8 1/2 inches; beam, molded, 48 feet; depth, molded to awning deck, 33 feet 9 inches. The ship has three continuous decks and a partial orlop deck at the forward end of fore hold. She is rigged with two steel pole masts and necessary derricks and steam hoisting engines for rapidly handling cargo. As in all of the vessels of this line, the deckhouses are of steel. The engines are the triple expansion type, with cylinders 33, 52 and 84 inches in diameter, by 45 inches stroke. Three double-ended boilers supply steam at 180 pounds pressure. They are 13 feet 10 inches in diameter and 20 1/2 feet long. In working at full power the engines are expected to drive the ship at a speed of 17 knots.

Steamer Virginia.—On November 12th the passenger steamer *Virginia*, belonging to the Chesapeake and Ohio Railroad, was launched from the shipyard of the William R. Trigg Company, Richmond, Va. She is a twin screw steamer, 200 feet in length over all, 32 feet molded beam, 12 feet 9 inches molded depth, 9 feet mean draft and of a displacement of 675 tons. There are two main engines estimated to develop 2,700 horse-power, of vertical direct acting triple expansion type, with high-pressure cylinders 17 inches intermediate pressure, 27 inches and low pressure, 43 inches in diameter. The two boilers are of the Thornycroft type, with 8,000 square feet of heating surface, and for 250 pounds steam pressure.

QUERIES AND ANSWERS.

Q. Can a shunt wound motor be made to run as a dynamo? If so, what changes are necessary in the winding of the connections? How can I change the direction of rotation of a dynamo, also of a motor? If a shunt wound motor can be converted into a dynamo, will it run in the same direction or not? S. H. M.

A. To convert a shunt wound motor into a dynamo, all you have to do is to belt it to a source of power running at the same speed or a little higher than it ran as a motor, and in the same direction. It is not necessary to make any changes in the connections or winding. If the machine is run at the same speed as it developed as a motor the voltage will be slightly lower than that of the current that operated it as a motor. The reason for this difference is, that when the machine runs as a motor a portion of the voltage of the current that is applied to it is absorbed in overcoming the resistance of the armature, and when the machine is run as a dynamo a portion of the voltage it develops is likewise absorbed by the armature resistance; hence, the difference between the voltage of the current that operates it as a motor and the voltage it gives when running as a dynamo is equal to both the above losses. To make the matter more clear, suppose that when the machine is running as a motor it makes 1,000 revolutions per minute with a current of 100 amperes under a pressure of 100 volts. Assume that the resistance absorbs five volts; then the counter electro-motive force or back pressure of the armature will be 95 volts. Now, if the machine is run as a dynamo at the same speed (1,000 revolutions) it will develop the same voltage, 95, and if the current generated is 100 amperes, the resistance of the armature will absorb five volts, the same as when running as a motor; hence, the net electromotive force appearing at the binding posts will be 90 volts. Thus it will be seen that to run the machine as a motor at 1,000 revolutions when the current is 100 amperes 100 volts will be required, and if it is run at 1,000 revolutions as a dynamo the voltage it will give when the current is 100 amperes will be 90. If it is desired to obtain 100 volts the machine will have to be run faster, but the speed will not have to be increased as much as the difference in voltage, because when the voltage is increased the strength of the current passing through the field coils will increase, thus rendering the increase in voltage greater than the increase in speed. If the machine is used as a dynamo a field-regulating rheostat must be provided so as to provide for adjusting the voltage to the point desired.

2. The direction of rotation of a dynamo or a motor can be changed providing the brushes are set perpendicular to the commutator surface, or if inclined, are of such form that they can be reversed so as not to run against the grain, so to speak. To reverse the direction of rotation of either a motor or a dynamo all that is necessary is to reverse the wires that connect with the commutator brushes.

Q.—As I understand it, the life of an incandescent lamp depends upon the quality of the vacuum within the bulb. If such is the case, how can the nature of the vacuum be determined? A. F. F.

A.—The quality of the vacuum has a great deal to do with the life of an incandescent lamp. If there were no vacuum the filament would be burned out in a few seconds. The more perfect the vacuum, the longer the lamp will last, other things being equal. The easiest way to test the vacuum is by means of an induction coil. The base of the lamp is connected with one of the terminals of the secondary coil, and the other terminal is placed about half an inch from it. If the coil is of proper size and the room is dark, a dim glow will fill the globe if the vacuum is not very good; but if it is nearly perfect there will be only a slight flash. This test cannot be made by every one,

because in addition to requiring a suitable induction coil it is necessary to have some experience in such work so as to be able to judge accurately from the appearance of the light within the globe as to the quality of the vacuum.

Q.—If the mica insulation between the commutator segments drops out is there any danger of the machine being damaged, that is, if enough of it is left in place to hold the segments firmly in their proper position?

F. R. W.

A.—If any portion of the insulation between the commutator segments or between the ends of the segments, and the clamping ring drops out, there is a strong probability that the cavity so formed will fill up, and the filling is almost sure to contain metallic particles which will short circuit the segments and thus burn out some of the armature coils. Owing to this fact it is necessary to fill up such cavities in as substantial a manner as is possible under the circumstances. If the cavity is large it may be possible to force sheet mica into it, the pieces being cut so as to fit the space. These pieces should be covered with thick shellac varnish on both sides when finally driven into place. If the cavity is too small to be filled by fitting in sheets of mica, it can be filled with a mixture of ground mica and shellac varnish. In either case the cavity must be thoroughly cleaned before the filling is inserted, and the latter should be pressed in as tight as possible so as to force out all the superfluous varnish. After the repair has been made the machine should be allowed to stand idle for at least twenty-four hours to give the varnish time to dry.

Q.—Will coating part of a furnace, that is pitting, with white zinc hurt the furnace any, and do you think it will stop the pitting? If you know of any better remedy, please let me know.

F. C.

A. A coating such as that referred to may prevent a continuance of pitting in two ways, (1) by providing a covering which will completely and efficiently protect the surface of the steel from external influences (2) by neutralizing these external influences so that they will have no effect on the steel. Any coating which will stick to the steel and which is itself neutral to it will act in the first manner. If in addition it consists of such materials as will tend toward neutralizing the harmful influences at work, it will act in both ways. A wash of Portland cement is sometimes applied in such cases. This acts simply in the first way. A coating of white zinc if it can be made to stick tightly will act to some extent in both ways. It will protect the steel directly and it will serve to divert electro-chemical action from the steel, as well as to reduce somewhat the acidity of the water, should acids be present. White zinc can at least be applied in the expectation that it will not injure the boiler, and if it can be made to adhere tightly it should prove decidedly beneficial.

Q.—As I understand it, a double pole switch is simply a combination of two switches placed in the two wires running from the machine, so that when it is opened, it breaks the circuit in two places. A single pole, double break switch, I understand, is placed in one of the wires running from the generator, but when it is opened it breaks the circuit at two points, just the same as the double pole switch. As a matter of fact, are not the two kinds of switches practically the same? If they are not, what is the difference between them?

W. G.

A.—Although both types of switches open the circuit at two points, they are very different practically. When a double pole switch is opened it disconnects the generator from the line on both sides—that is, both the wires running from the binding posts of the machines are disconnected, so that the circuit is left entirely dead, as it is called. The double break single pole switch opens the circuit at two points, but it only disconnects one side of the circuit, so that the machine is not entirely disconnected and the circuit is not entirely dead. Under these conditions, if there should be a ground connection at some point in the circuit and another one in the machine, the opening of the switch would not stop the flow of current as the circuit would still be completed through the ground connections, and the side of the line not opened by the switch.

Q.—What would be the effect if a voltmeter and an ammeter are wrongly connected with the circuit, that is, the voltmeter being connected as an ammeter, and the ammeter as a voltmeter?

H. T. S.

A.—If a voltmeter is connected like an ammeter the current flowing through it will be greatly reduced, owing to the very high resistance of the instrument. If the voltage of the circuit is, say, 115, and the instrument is made to measure this pressure, it will not be injured in the least, but the current flowing in the circuit will be an insignificant fraction of an am-

pere, insufficient for any practical purpose. If an ammeter is connected across the circuit—that is, in the same way as a voltmeter—it will practically constitute a short circuit, and if the generator is driven by an engine powerful enough to keep it going the armature would be burned out and the instrument would also be destroyed. This would be the result if the circuit were not protected by fuses or circuit breakers. On this account it is always advisable to place a safety fuse in series with an ammeter, so that if by mistake it is connected across the circuit the fuse will melt and thus prevent injury.

Q.—What is a wattmeter used for? What is the difference between a wattmeter and an ammeter? Is there any difference between a wattmeter, a recording wattmeter and an integrating wattmeter?

K. Y. W.

A.—An ammeter indicates the strength of the current flowing through it. A wattmeter indicates the power, which is measured in watts, flowing through it. An integrating wattmeter is for the electric circuit what a gas meter is for a gas distributing system—it indicates upon dials the amount of electrical energy that has passed through it. It is called an integrating meter because it adds up all the energy that passes through it. A recording wattmeter is the counterpart of a recording steam gauge; it marks a line upon a sheet of paper, which shows the amount of power at any time within the period covered by the record line.

Q.—How can a direct current transformer be made? Suppose you have a direct current of 100 volts, and desire to obtain one of 1,000 volts, could an alternating current transformer be used for the purpose? How do you find the proportions of the transformer to give any desired voltage in the transformed current?

B. T. S.

A.—It is not possible to make a direct current transformer similar in design to an alternating current transformer. The latter is a stationary apparatus and cannot be used with direct currents. A direct current transformer is simply a combination of an electric motor and a generator; the primary current drives the motor, and the motor rotates the generator, the latter generating the secondary current. The name transformer is misleading, as it creates the impression that the apparatus in some way transforms the current, which, as a matter of fact, it does not. The primary current in a transformer, whether of the alternating or direct current type, acts to generate an entirely independent current, which is called the secondary; hence there is no actual transformation, but, instead, the power of the primary current is used to generate another current of the voltage required.

Q.—Can storage batteries be charged with any kind of generator, or is a certain kind necessary? If so, what kind?

J. O. F.

A.—Strictly speaking, storage batteries can be charged with any kind of continuous current generator that develops a sufficiently high voltage. Practically, however, only shunt and compound wound generators can be used advantageously. Arc light machines, and even other batteries of a larger number of cells, can be used; but in such cases it is necessary to have an ammeter and a voltmeter connected with the battery, and suitable means for maintaining the voltage and current at the proper points. This means that the charging operation must be constantly watched. All this can be done for an isolated experimental case, but for practical work it would not pay.

Q.—Can electric motors be run belted to the same shaft? In other words, suppose you desire to obtain fifty horse power, and have three motors, one of ten and two of twenty horse power, can the three be belted to the same shaft and act together, or will they act like horses pulling unevenly in the traces?

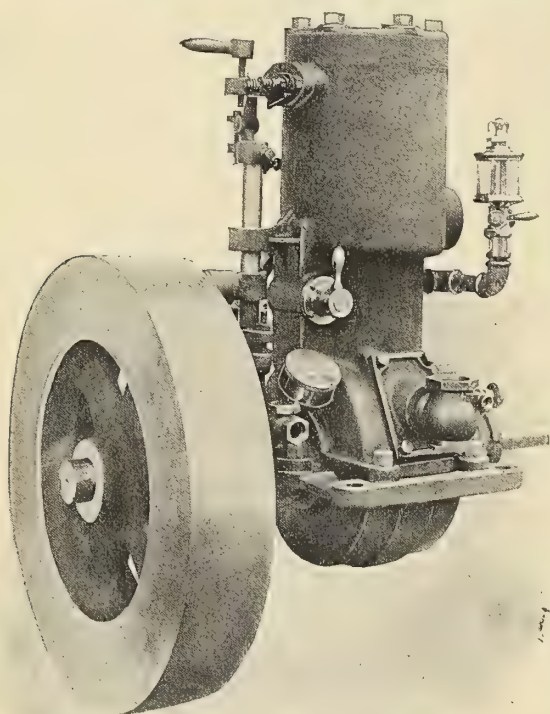
K. H.

A.—If the motors are series wound, they will all pull together under any conditions, but to secure the best results it is necessary that the pulleys be properly proportioned, so that the three machines may run at their normal speeds when the full load is being delivered. If the motors are shunt wound, they must be provided with proper size pulleys, for, if not, the machines that run slow will drive the other one far above its proper velocity and thus convert it into a generator, so that it will absorb the power of the other motors, or a portion of it. This action will not represent an actual loss of energy, for the power absorbed by the machine acting as a generator will be given back to the circuit in the form of current generated, and the only loss will be that due to the transformation in the machine. If the motors are belted so as to all run at the proper speeds, they will all act as motors, but to make them divide the load equally they will have to be accurately adjusted, precisely the same as if they were generators. For this purpose each machine should be provided with a field rheostat, so that the field current can be adjusted until the armature current is the proportionate amount.

ENGINEERING SPECIALTIES.

Marine Engines.

Among the advantages of the gasoline marine engines are that neither government inspection nor licensed engineer or pilot are required; the engine occupies small space, and for power developed is lighter than a steam engine and boiler; it is ready to run at a moment's notice; the instant that it stops the consumption of gasoline stops, and there is no fire to be troubled with, nor the consequent cleaning of boilers. It is, furthermore, free from danger, as the combustion takes place within the cylinder. Ordinary stove gasoline may be used, which is sold at any grocery or country store. Gasoline engines are of two separate and distinct types, the "four cycle" and the "two cycle" type. The four cycle engine gives an impulse

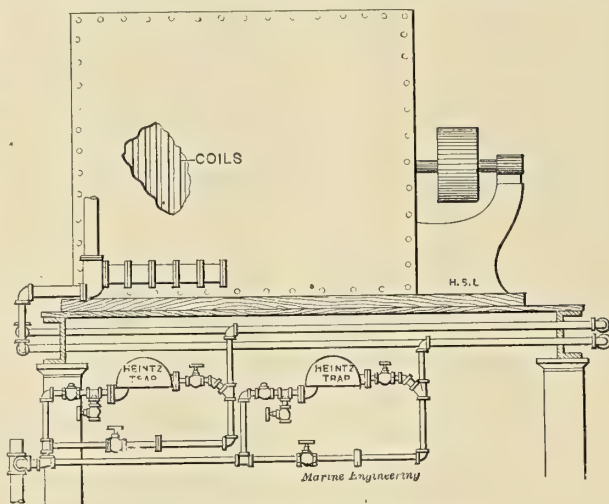


CLIFTON GASOLINE ENGINE.

to the shaft at every other revolution, while the two cycle engine gives an impulse at every revolution. The engine illustrated is of the two cycle type, but has a great many improvements which render it as reliable as the four cycle type. It may be started with but a few moments' preparation, and will take care of itself from that time on, an occasional filling of the lubricator only being necessary. This engine is built by the Clifton Motor Works, of 229 East Clifton avenue, Cincinnati, Ohio, who are making a line of marine engines from 1 1/2 H. P. to 16 H. P. The crank shafts are large and strong, the bearings have large surfaces and are made of the best material. The sparking device and all fittings are of approved construction. The larger engines are built on the four cycle principle, with two and four cylinders.

Heintz Traps.

The trap herewith illustrated is one of many used in the heating system at the works of the New York Shipbuilding Company. It has been placed in many cases, on individual coils, and in others as shown in the cut, on the Sturtevant coils. The condensed water is removed from the coils without loss of live steam. There are only five parts to the Heintz trap, and its operation depends upon the expansion of a secret fluid confined in a U-shaped vacuum tube. Steam enters the trap casing through the valve, which in its



TRAPS ATTACHED TO HEATING COILS.

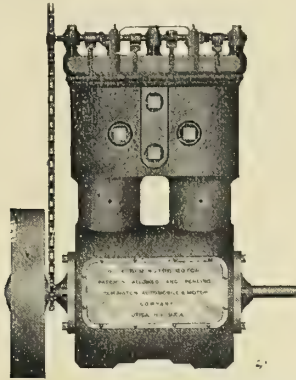
normal condition is open, and in passing through the trap heats the tube spring almost instantly. The heating causes the expansion of the liquid in the tube spring, which closes the valve and thus prevents the loss of live steam. A change of temperature of one degree operates the trap. Water up to 211 degrees is allowed to pass, but the trap closes at 212 degrees.

By the use of these traps the efficiency of the heating coils is said to have been increased and at a considerable saving of fuel. The manufacturer is the William S. Haines Company, Eighteenth and Hamilton streets, Philadelphia, Pa.

Remington Motors.

The Remington Automobile and Motor Company are prepared to accept orders for a hydro-carbon motor of their own construction, exclusively their own design, and to be sold under their guarantee. These motors are of the two cylinder variety, four cycle type. The crank pins are set parallel to the main shaft, thereby giving a positive explosion at every revolution. The various sizes are produced as small as is consistent with good running qualities and to obtain positive power, and the design permits of compactness and simplicity. These motors will operate in either a horizontal or vertical position and are equally well adapted to both marine and automobile purposes, and by the addition of a governor may be utilized for successful stationary work. The ignition can be either of the jump type, make and break type, or wipe type, as desired. The exterior of the motors will not admit of that high finish, which, it is true, is apt to attract the

eye of the purchaser, but the interior or the working parts are manufactured by the most skilled mechanics, and in the best possible manner, of the finest material. The pistons, packing rings, wrist pins, valves, excen-



REMINGTON HYDRO-CARBON MOTOR.

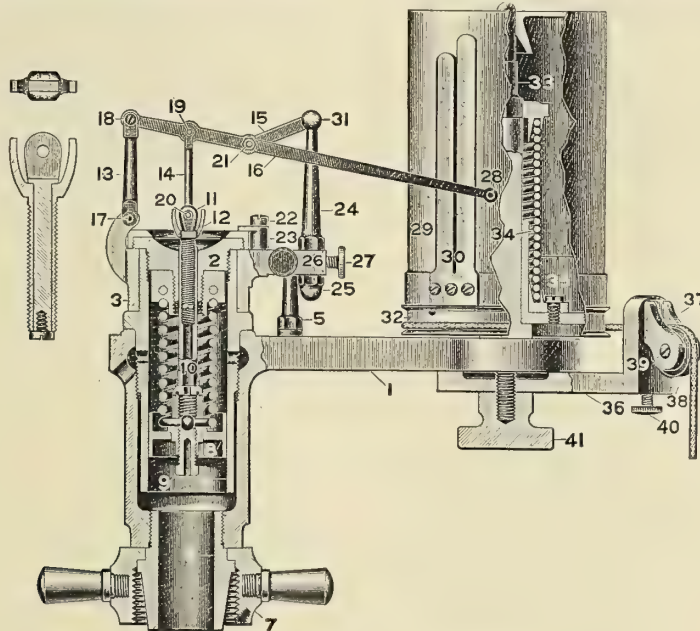
trics, sprockets, shafts, and, in fact, all parts are carefully made to gauge, thereby permitting of an interchangeability of the parts, rarely found in a gasoline motor. The main office and factory are at Utica, N. Y.

The Star Indicator.

Wishing to make their line even more complete, the Star Brass Manufacturing Co., Boston, Mass., have brought out the Star-Improved Steam Engine Indica-

on the principle of utilizing ideas that have proved their worth instead of striving to have new or different designs, regardless of utility. The pencil movement is of the Thompson pattern, chosen for its strength, durability and light weight. The springs have the ball at lower end, which has proved so satisfactory in years of service. The drum spring, as will be noticed, is a plain helical coil—another device which has proven its worth in actual service. The interior cylinder or shell carries the cap at the top, always insuring alignment between piston and rod. This in no wise interferes with removal of shell, should it become necessary. Around this shell is a steam space which, being filled with live steam, jackets the working cylinder and secures uniform temperature and expansion.

A feature which will be appreciated by those who have vivid but unpleasant memories of burned fingers is the non-conducting cover over the cap at top of cylinder. This enables it to be removed both rapidly and with comfort. A vent tube is also provided for carrying away the waste water and steam, and avoids the necessity for acrobatic performance in keeping the hand away from the hot drippings. The vent tube extends below the body of indicator, keeping the drips entirely out of the way. As it is sometimes desirable to vary the position of the atmospheric line on an indicator card, provision is made for adjusting the piston rod by means of the swivel head shown. The pawl and ratchet detent motion has been replaced by the well-known ball form of friction clutch, not shown in



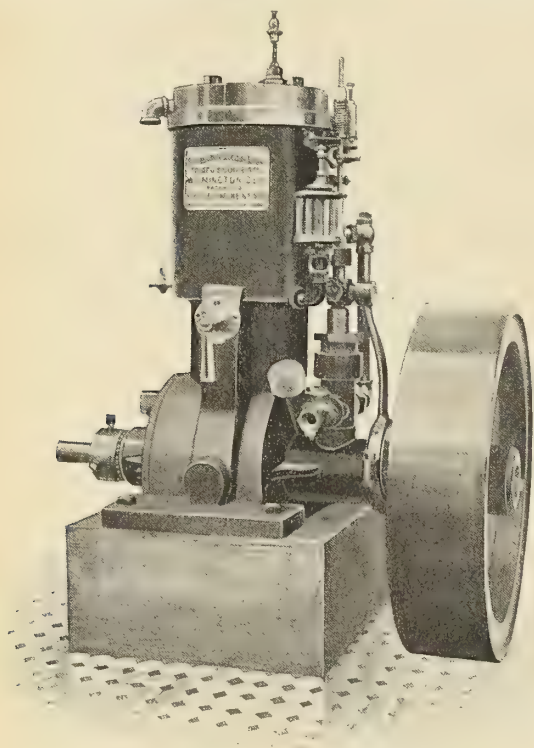
SECTIONAL VIEW OF STAR INDICATOR.

tor, and have equipped their shop with all the machinery and tools necessary for their production. Especial attention has been paid to the springs, and a special apparatus, electrically controlled, has been devised for testing them in the best manner. Those familiar with the Thompson indicator will note a familiarity in the lines of the "Star," but this has been done

detail cut. The whole instrument has received careful attention, from the body to the smallest part, and the design denotes strength as a foundation for its other good qualities. The makers are also prepared to furnish complete outfits including indicators, blanks for taking cards, springs for different pressures and duplicate parts.

The Harris Marine Gasoline Engine.

Owners of pleasure yachts and large working vessels, and those acquainted with marine engines, will be interested in the accompanying illustration of a two-cycle 6 horse power single cylinder gasoline marine engine, here illustrated, formerly named the Hercules, but now known as the Harris marine gasoline engine. This engine represents a high type of design and strong construction, as all delicate parts heretofore so common in the gasoline engine, have been discarded and provision made for taking up lost motion, all parts being easy of access. Twelve years'



SIX H. P. HARRIS MARINE GASOLINE ENGINE.

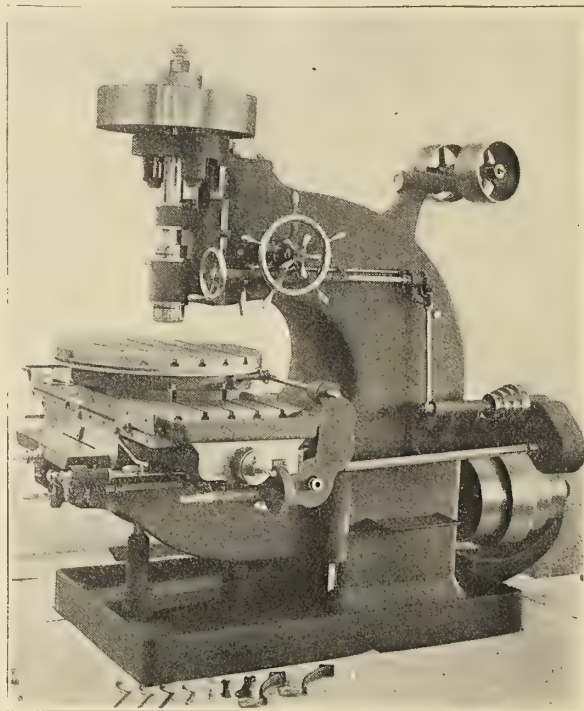
experience in the manufacture and installation of engines in various kinds of craft from a yacht tender to a barge and oyster dredging vessel enables this firm to construct the engine in the simplest manner. They are built with one, two, three, four and six cylinders to develop from 1 1-2 to 160 horse power, and are claimed to run smoothly under the most trying conditions. Further particulars may be had by addressing C. B. Harris, general manager of the Delaware Machine Works, Wilmington, Del.

Vertical Milling Machine.

The Becker Brainard vertical milling machine has been designed in order to meet repeated inquiries for an extra heavy vertical spindle machine of larger capacity. As an indication of the general utility of this machine, it is interesting to note that with the exception of screw machine work, shafting and spindle-work, everything which would otherwise be done on the lathe and planer in finishing the smaller sizes of

the horizontal milling machine made by this company can be done on the No. 7 vertical milling machine at a great saving of expense.

The knee is supported upon two elevating screws, thus giving it the maximum of stability. The standard is strongly bolted to a heavy base plate casting, which may be set in a recess built in the foundation, so as to bring the operating levers, hand wheels, etc., within easy reach of the workman. Though twice the weight of the No. 6 miller, it is fully as easy and economical to manipulate when used on the lighter class of work. In fact, it is an all-around machine, capable of doing the finest milling or of crowding to the limit on large work.



VERTICAL MILLING MACHINE.

The specifications given below cover the general proportions of the standard No. 7 vertical milling machines when provided with feed of 60 inches. The same machine can be furnished with table feed of 72 inches and 84 inches.

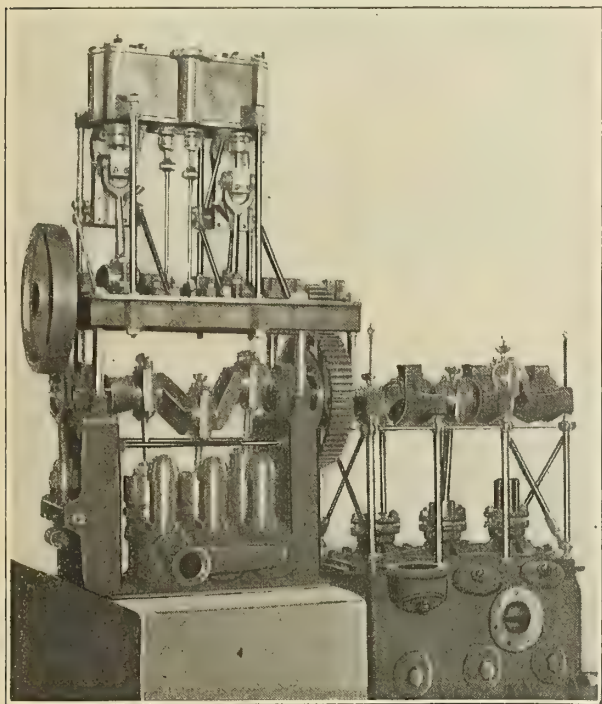
Size of platen inside oil pocket.....	53 x 26 inches
Length of saddle.....	72 1/2 "
Longitudinal feed, automatic.....	60 "
Cross feed, automatic, with stop.....	30 "
Vertical feed, of spindle, automatic.....	15 "
Feed per revolution of cutter.....	.0035 to .565 "
Range of spindle speeds.....	3.5 to 360 "
Greatest distance between spindle and platen.....	26 1/2 "
Greatest distance between spindle and rotary platen.....	20 "
Distance between center of spindle and neck.....	31 "
Vertical adjustment of knee.....	15 "
Diameter of spindle, main bearing.....	4 1/2 "
Diameter of spindle driver (back geared 8:1).....	28 "
Diameter of rotary table, inside oil pockets, 32 in.; outside.....	36 "
Size of hole in spindle ..	B. and S. Taper No. 13
Speed of counter ..	fast, 320; medium, 200; slow, 75
Diameter of pulleys on countershaft (5 1/2 in. belt)	18 in., 18 in. and 22 in.

Further inquiries should be addressed to the Becker-Brainard Milling Machine Company, Hyde Park, Mass.

Air and Feed Pumps for Steam Yacht Arrow.

The steam yacht *Arrow*, belonging to Mr. Charles R. Flint, and resembling a torpedo boat in appearance and construction, is being fitted with two sets of air and feed pumps operated by independent engines. Each set consists of three air pumps, 7 3/4 inches diameter, and three feed pumps 3 1/4 inches diameter, the stroke of all being 4 inches. They are designed to run at about 100 revolutions per minute, at which speed the engines running the pumps will be turning 350 revolutions per minute.

The general arrangement of the pumps and their engines is shown in the figure, from which it is seen that the air pumps are inboard in each case, and the feed pumps, surmounted by their engines, outboard. The condenser is at the after end of the engine-room, while



INDEPENDENT AIR AND FEED PUMPS FOR STEAM YACHT ARROW.

the air and feed pumps are against the forward engine-room bulkhead.

Heretofore air pumps built upon this general plan have been single acting, but in this case the space is so limited that the pump cylinders are necessarily of small diameter, and are arranged to operate upon the up stroke as well as the down stroke. The suction ports are in the middle of the travel of the pistons, and the discharge occurs through valves at the top and bottom of each cylinder. The three cylinders are in one casting, and on account of the lack of space, were put so close together that the suction ports on one side of the athwartship center line do not connect with those on the other side. This, together with the peculiar arrangement of the keelsons, made it necessary to divide the suction pipe from the condenser into two branches, one connecting with the after side of the cylinders, and one with the forward side. This, however,

is something of an advantage, as it distributes the inflow of water evenly between the three cylinders.

The pumps are provided with ample hand holes, located so that the valves can be easily overhauled.

The crankshaft for working the air pumps is supported by light composition bearings carried upon nickel steel columns, secured to the top of the pump body. The feed pump shaft is in line with the air pump shaft and connected with it by a flange coupling, between the flanges of which is placed the gear for turning the shafts, this gear being of forged steel, made very light, and secured in place by the crankshaft coupling bolts. The shafts themselves are of forged steel made hollow for lightness.

The three feed pumps of each set are outboard of the air pumps, and draw from a hot well so placed that there is always a head of water on the suction valves. The feed is discharged to the boilers through a heater, and the pumps are designed to work against a boiler pressure of 400 pounds per square inch.

The castings for the air and feed pumps are of Government bronze, 88 per cent copper, 10 per cent tin and 2 per cent zinc, and the builders have been successful in obtaining very satisfactory castings throughout.

The steam engines for running the pumps are of the double high pressure type, having cylinders 4 1/4 inches diameter by 5 1/2 inch stroke, designed for a steam pressure of 250 pounds per square inch.

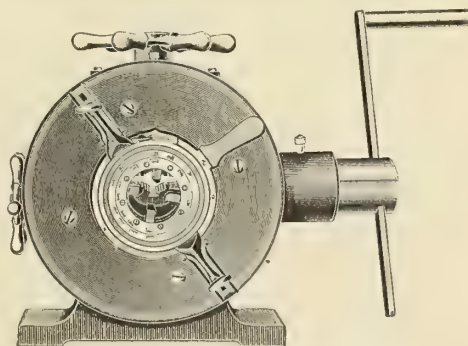
At the outboard end of each pump shaft is an eccentric, which works a small bilge and cooler pump for engine-room service.

The design of the pumps and engines embodies the extreme of lightness consistent with the requisite strength, and the highest quality of material has been used in the construction.

These pumps were designed by Mr. C. C. Thomas, and were built by Messrs. W. D. Forbes & Co., of Hoboken, N. J.

Pipe Threading Machines.

The Oster Manufacturing Company, No. 106 East Prospect street, Cleveland, Ohio, is now placing on the market a new pipe threading machine for bench



OSTER PIPE THREADING MACHINES.

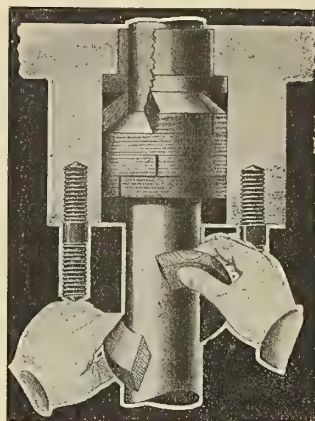
use, and one for power, with hand attachment. The former, which is designated as No. 200, is illustrated herewith. It embodies the good features found in hand tools of this make, and has a capacity of 1-4-inch

to 2-inch pipe. It has the Oster patent expanding die head, graduated on the face plate, with quick opening dies controlled by a simple cam movement, without the use of screw-driver, wrench, hammer or other tool. By the use of the patent adjustable positive stop, the operator is enabled to cut any number of duplicate threads with absolute accuracy. The dies are adjustable to all variations in the pipe and fittings. The vise is accurately made to center the pipe perfectly, thus insuring straight threads. The pipe is drawn up to the dies by hand wheel, rack and pinion. Every piece entering into the construction of this machine is accurately made and of the best materials. The manufacturers invite inquiry upon this machine, both in the matter of price and with regard to other particulars, which they will be pleased to furnish.

Cutting-Off Machine.

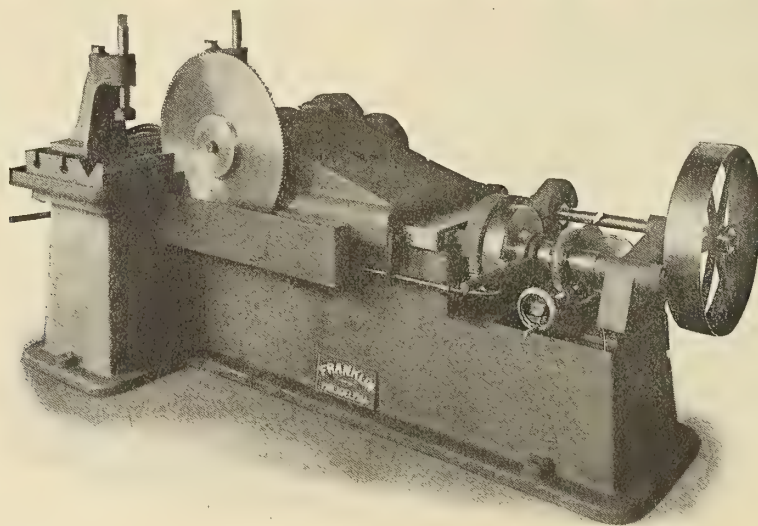
A cold saw cutting-off machine that can be used to advantage in shipyards is made by the Franklin Machine Works., Inc., of Philadelphia, Pa. The machine illustrated is a No. 3 bar saw. The saw, which is 30 inches in diameter, is driven with a phosphor bronze

made to fit exactly the rod and box, and can be easily applied and removed from the stuffing box, as shown in the illustration. As these packing rings are funnel



METHOD OF APPLYING GALVANIC METALLIC PACKING

shaped and elastic, the gas or liquid pressing on them automatically tightens the packing, thus making the stuffing box tight as the pressure increases. On ac-



FRANKLIN COLD SAW CUTTING-OFF MACHINE.

worm wheel and hardened crucible steel worm. The machine embodies a number of late improvements, and is built of the very best materials. The rate of automatic feed is variable, and the capacity is a nine-inch round bar or an eight-inch square.

Galvanic Metallic Packing.

This packing is composed of very thin rings of "galvanic metal," alternating with thin layers of a non-metallic, but lasting, and lubricating material, such as high-grade canvas chemically and mechanically prepared and lubricated. The alternate rings of metal and canvas are united to form funnel-shaped split, elastic bushings from 1-8 to 1 inch thick, proportionate to the size of the packing. These packings are

count of the oil absorbing and restoring quality of the thin layers of prepared canvas, only a small quantity of lubricant is required to keep the packing well and constantly lubricated. It is used to pack steam, air, water and ammonia. Further particulars may be had by addressing the Galvanic Metal Paper Company, 18 Morris street, Jersey City, N. J.

Perth Amboy Shipyard.—The Standard Shipbuilding Company of Perth Amboy, N. J., has been organized for the purpose of building and repairing steel and wooden vessels of every description, marine engines and boilers. Its property formerly was known as the Ramsey Shipyard. Vessels up to 450 feet in length can be built, and the various shops are well located and equipped with modern tools.

Steamboat Northam Strikes Drawbridge.

While approaching her dock in New Haven on October 4, the steamboat *C. H. Northam* ran into an abutment of the Tomlinson drawbridge, the accident was the cause of the engine stopping on a dead center whereby the engineer could not reverse the engine when the signal was given from the pilot house. The pilot steered the steamer into the bridge in order to save several tugs that lay in a nearby slip.



COLLISION OF THE C. H. NORTHAM.

The prow of the boat buried itself 12 feet in the trap rock crib, tearing through the timbers. The bow struck the street-car tracks and bent up the road bed. On the following flood tide the steamer was floated off and will be repaired.

City of Trenton.—The views of the *City of Trenton* which appeared in the November issue of *MARINE ENGINEERING* were loaned by the Philadelphia *North American*, to whom credit should have been given.

British Royal Yacht.—The royal yacht *Victoria and Albert* has finally been officially pronounced sea worthy. When she was first given a trial trip it was found that her weights of machinery and hull were so placed as to leave her with dangerously little stability. The vessel underwent extensive repairs, which amounted almost to rebuilding.

Russian Battleship Retvizan.—A second trial of the Russian battleship *Retvizan* was recently made. The coal consumption, including auxiliaries, amounted to 1.8 pounds of coal per horse power when the engines were indicating 18,300 horse-power. At the completion of the twelve-hour trial a twenty-four-hour trial at 10 knots was made to determine the coal consumption and the radius of action of the ship at that speed. The amount of coal consumed during the twenty-four hours showed that a radius of action of 8,800 knots is obtainable by 2,000 tons of coal, which is the bunker capacity. Another trial, lasting two hours, to determine the most economical coal consumption, was made, and for this a speed of 100 revolutions of the engines was taken, using all the boilers. The results show that 1.55 pounds of coal were consumed per hour. The engines developed 7,820 horse-power and drove the ship 16 knots.

NEW PUBLICATIONS.

Country Life in America, published by Doubleday, Page & Co., Union Square, New York, has found a welcome of unexpected proportions and enthusiasm. No more superbly illustrated magazine has ever been printed.

Among the contents is an article by the editor on *Abandoned Farms*, with charming illustrations; an illustrated account of Ex-Governor Levi P. Morton's place, Ellerslie; a two page collection of suggestive pictures of *Pleasant Country Homes*; the history of the frog from tadpole to froghood, with remarkable photographs by A. R. Dugmore, made from life; articles on planting the lawn, the art of letting things grow, the newest fruits, and a vast amount of practical matter about the garden, the greenhouse, etc.

Central Station Experiences. Size 6 x 9 inches, pp. 106, with cuts. Power Publishing Co., New York.

According to the subtitle, this little book is a series of narratives on the trials and tribulations of a steam engineer while learning to run an electric station. It is divided into sixteen chapters, dealing with the various problems which might be expected to arise in ordinary central station practice. These chapters are cast in the form of a series of narratives detailing the experiences in a central station in a town called Millville. While the main purpose of the narratives is instruction, they are told in an entertaining colloquial form with a vein of humor running through, intended to amuse and interest as well as to instruct. Many of the cuts are of the same character, and the whole is a very successful attempt to give a large amount of instruction regarding the every day problems arising in central station practice in the form of a series of entertaining narratives. The book should not fail to interest as well as instruct all who are concerned with this field of engineering work.

The Construction of a Gasoline Motor Vehicle, by C. C. Bramwell. Size 6 x 9 inches, pp. 149, with cuts. Emil Grossman and Bro., New York.

This book is the result of a series of articles written for the *Motor Vehicle Review* by the author, and edited for publication in the present form by Mr. E. W. Graef. The subject is presented under fourteen chapters, dealing first with the general principles and mode of operation of four-cylinder motors, followed by the design of the motor and of the vehicle complete. The subject matter is very clearly presented, and the opening chapters give an excellent general discussion of small gasoline motors. The discussion of the design is clear and in sufficient detail, so that no difficulty should be experienced in the construction of a motor and vehicle from the plans given. The drawings give full dimensions, and are mechanically correct. They are also in sufficient detail so that all important parts of the equipment are clearly presented from the mechanical point of view.

While the book primarily deals with the designs and construction of a single motor and vehicle of a definite size and type, the accompanying discussion of the subject of such motors in general and of their design

and construction is perhaps of more value to the general reader interested in such subjects.

To all who are interested in motor vehicles this book will form a welcome addition to the literature of the subject, and it may be recommended as a book written with a definite purpose in view and well adapted to fulfil such purpose.

SELECTED MARINE PATENTS

684,486. ADJUSTABLE RUDDER. ELIJAH F. WEES, POINT PLEASANT, W. VA., AND WILLIAM H. MARTIN, GALLIPOLIS, OHIO.

CLAIM.—A rudder comprising a main blade, a supplemental blade adapted to project beyond the main blade to increase the area thereof, and a hinged plate arranged on the exterior of the rudder at the bottom thereof, and connected with the main blade and with the supplemental blade, substantially as described.

684,749. VENTILATING SYSTEM FOR VESSELS. ALEXANDER K. FINLAY, NEW ORLEANS, LA.

CLAIM.—A storage system for transporting tropical fruits, comprising a closed cargo space, vertical partitions or bulkheads secured in the cargo space and dividing the same into separate compartments, an air compressor, a water chamber with coil therein receiving the air from said compressor, a cooling chamber connected to said coil, an air reservoir, a mixing chamber connected to said reservoir, and also to said compartments, and an air pump and pipes delivering air from said mixing chamber to said compartments, substantially as described.

685,089. PROPELLER. JOHN BARNETT, LOS ANGELES, CAL.

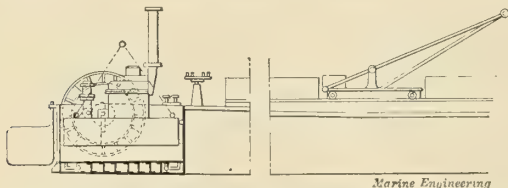
685,158. LIFE-PRESERVER. ICILIUS W. MACCOLINI, INWOOD, N. Y.

CLAIM.—A life-preserver, comprising hollow sleeve-shaped portions composed of flexible material and adapted to fit around the upper arm, and through which the arms are adapted to be inserted, said parts being connected by a flexible tube adapted to pass across the back or breast, and which is provided with a nozzle or mouthpiece connection, substantially as shown and described.

685,195. LIFE-PRESERVER. HANS ANDRESEN, FLENSBURG, GERMANY.

CLAIM.—A life-preserver belt, comprising a main body, air cells secured thereon longitudinally and closed at both ends, an air chamber, a supply pipe leading therefrom, a series of flexible tubes connecting the air chamber with the air cells near one end, and a clamping device secured to the belt at the opposite end of the cells adapted to enclose the inflating tubes, and also serve as a buckle or clasp for the garment, substantially as described.

685,591. CARGO VESSEL. FRANCOIS A. FERNEZ AND LEOPOLD J. BREUER, PARIS, FRANCE.



CLAIM.—A boat provided with a separately supported motive mechanism, adapted to be raised and lowered in the boat bodily, substantially as and for the purposes set forth.

2. A boat having in it a water-tight compartment, means for introducing water to said compartment at will, a float within said compartment, and the motive mechanism of the boat mounted on said float, and adapted to rise and fall bodily therewith, substantially as and for the purposes set forth.

3. A boat having an open compartment to contain a support for the motive mechanism of the boat, said support being adapted to be raised and lowered in said compartment, the motive mechanism, mounted on said platform, and means carried by the boat for hoisting out said motive mechanism at will, substantially as set forth.

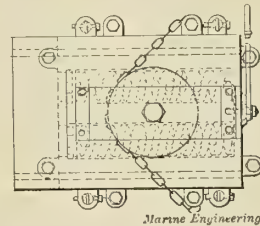
685,611. LIFE-PRESERVER. GEORG I. DE IRSA, VIENNA, AUSTRIA-HUNGARY.

CLAIM.—An automatic life-saving apparatus, comprising a receiving chamber for a suitable chemical, generating gas upon contact with water, a water inlet chamber separated from the receiving chamber by a porous partition, an inlet valve for the water chamber, an inflatable gas receiver communicating with the water chamber, and means for attaching the device to the person, substantially as set forth.

685,829. BOAT. VALDEMAR ENGELHARDT, COPENHAGEN, DENMARK.

CLAIM.—In a collapsible boat, a non-collapsible continuous gunwale and a non-collapsible bottom, collapsible sides connecting the gunwale and bottom, and a toggle-joint connection between the gunwale and bottom, adapted to be folded together to collapse the sides to lower the gunwale upon the bottom and to be extended or straightened to hold the gunwale and bottom apart to spread the collapsible sides.

686,317. YIELDING GUIDE-ROLLER FOR RUDDER CHAINS OF SHIPS. AUGUST MAY, HAMBURG, GERMANY.

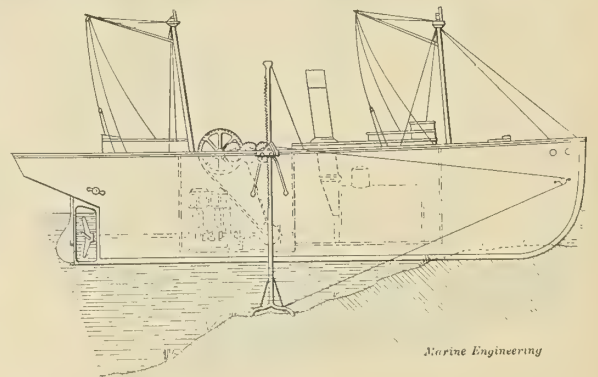


CLAIM.—The combination with a rudder chain, of an elastically yielding roller therefor, arranged to yield upon a diagonal, as stated, and means for locking said roller against yielding movement.

686,352. RIVETING MACHINE. WILLIAM SELLERS AND WILFRED LEWIS, PHILADELPHIA, PA.

686,412. LIFE-PRESERVER. ERNEST S. MAGNIN, CHICAGO, ILL.

686,597. APPARATUS FOR FLOATING VESSELS. ALBERT S. DEBOSE, CUERO, TEX.



CLAIM.—The combination, with a marine vessel, of a bracket affixed to the gunwale and having an arc slot, as described, a roller having a bearing adapted to travel in said slot, and means for retracting it to the top of the same, a spur-gear journaled in said bracket, a push-beam provided with a rack on one side and adapted to work between said roller and gear, and means for rotating the gear for raising and lowering the beam, substantially as shown and described.

2. The combination, with a marine vessel, and a beam provided with a rack and adapted to work vertically on the side of the vessel, means for raising and lowering and also guiding the said beam vertically, and a hauling rope connected with the foot of the said beam, and a pulley attached to the vessel's hull near one end of the same, the rope extending back over the deck, substantially as shown and described, for the purpose specified.

686,618. LIFE-PRESERVER. FLORIAN KRAJCA, CARLSRUHE, GERMANY.

CLAIM.—The combination of the waist-belt, having a buckle or like means for connecting its extremities.

686,646. MARINE TORPEDO. GIO ANSALDO, GENOA, ITALY.